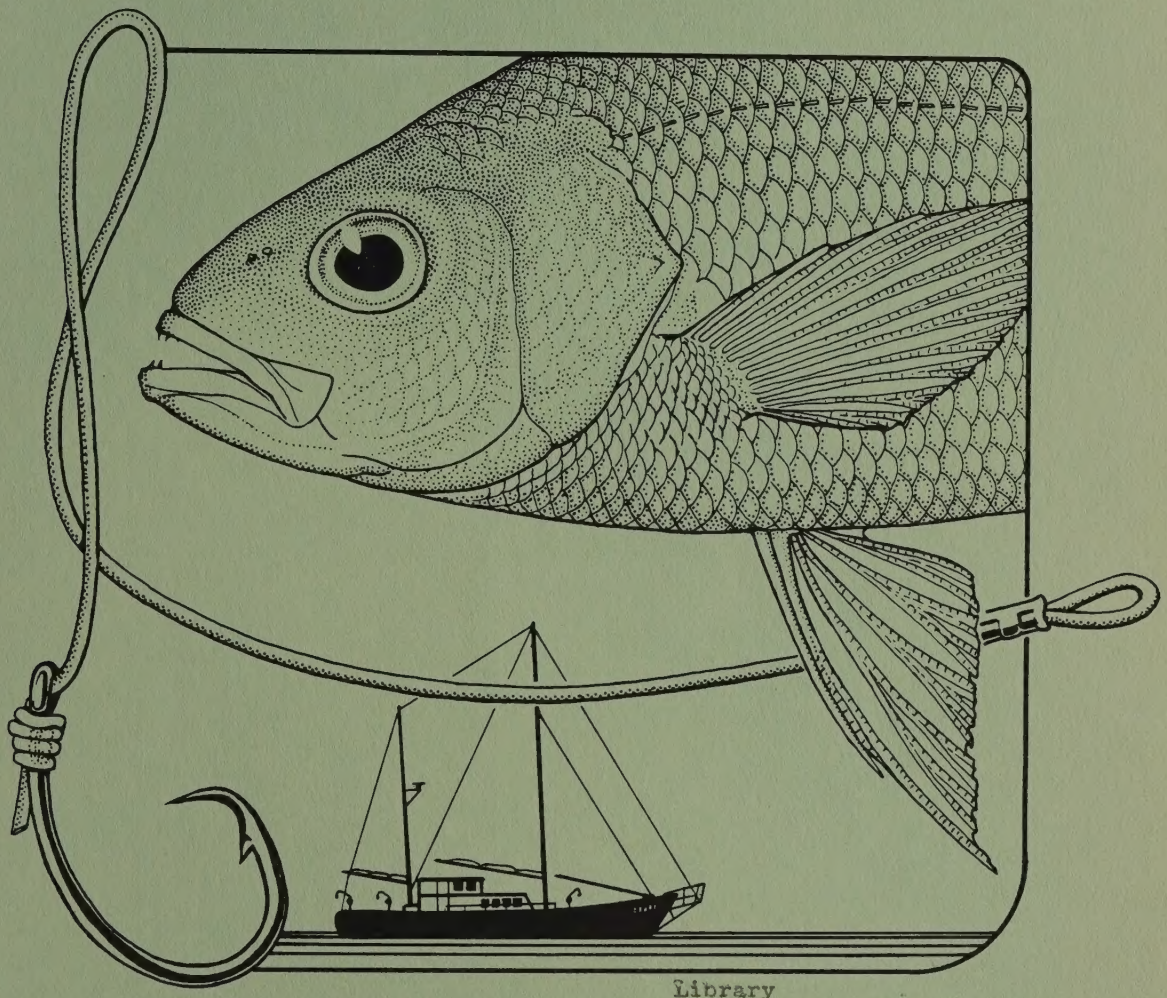
1987

1987 Annual Report

for the Fishery Management Plan for the

BOTTOMFISH AND SEAMOUNT GROUNDFISH FISHERIES OF THE WESTERN PACIFIC REGION



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OCTOBER 1988

PREPARED BY THE PLAN MONITORING TEAM
EDITED BY DORIS ALCORN AND JOHN SPROUL
FOR THE

WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL
1164 BISHOP STREET SUITE 1405 HONOLULU, HAWAII 96813 TELEPHONE (808) 523-1368

ILLUSTRATION BY DORIS ALCORN

BOTTOMFISH PLAN MONITORING TEAM MEMBERS

Mr. Alvin Z. Katekaru, Chairman
Marine Section Chief
Division of Aquatic Resources
Department of Land and Natural Resources
State of Hawaii
1151 Punchbowl Street
Honolulu, Hawaii 96813

Dr. Stephen V. Ralston
Task Leader, Insular Stock Assessment
National Marine Fisheries Service
Honolulu Laboratory
2570 Dole Street
Honolulu, Hawaii 96822-2396

Dr. David A. Somerton
Acting Task Leader, Seamount Resources Program
National Marine Fisheries Service
Honolulu Laboratory
2570 Dole Street
Honolulu, Hawaii 96822-2396

Mr. David C. Hamm
Manager, WPACFIN
National Marine Fisheries Service
Honolulu Laboratory
2570 Dole Street
Honolulu, Hawaii 96822-2396

Dr. Samuel G. Pooley
Industry Economist
National Marine Fisheries Service
Honolulu Laboratory
2570 Dole Street
Honolulu, Hawaii 96822-2396

Mr. Fritz Amtsberg
Commercial Fisherman
2168 Round Top Drive
Honolulu, Hawaii 96822

Mr. Brooks Takenaka
Marketing Agent
United Fishing Agency
117 Ahui Street
Honolulu, Hawaii 96813

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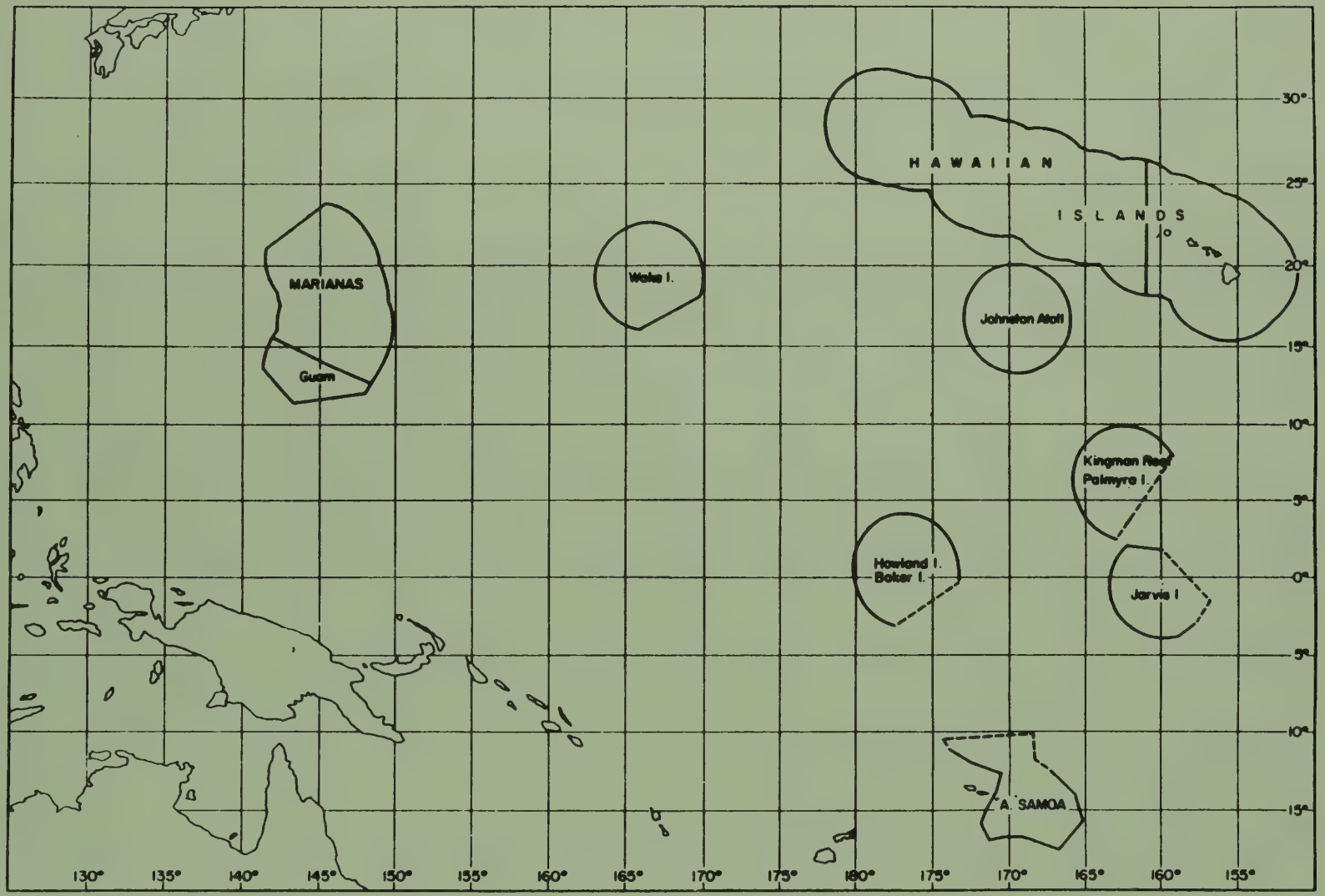


Figure 1. Jurisdiction of the Western Pacific Regional Fishery Management Council: boundaries of the 200 mile EEZ around Hawaii, American Samoa, Guam, the Northern Mariana Islands, and other U.S. possessions.

INTRODUCTION

Bottomfish Management in the Western Pacific Region

The Western Pacific Regional Fishery Management Council (the Council) was established by the Magnuson Fishery Conservation and Management Act of 1976. The Council is a federally sponsored organization (under NOAA, Department of Commerce) whose main task is to develop management plans covering various offshore fisheries within its geographic jurisdiction (Figure 1 and Appendix A). A Fishery Management Plan (FMP) was developed by the Council to manage and optimally utilize bottomfish and groundfish stocks in Hawaii, American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands. The FMP calls for an annual review of the fishery by a Bottomfish Plan Monitoring Team (BPMT) designated by the Council. The BPMT review consists of an annual report which is composed from a series of independent reports (modules); the modules are discussed by team members and then edited into a single report.

This is the second annual report on the bottomfish and seamount groundfish fisheries in the western Pacific region since the FMP was put into effect by the National Marine Fisheries Service (NMFS) in August 1986. The purpose of the yearly review, is to: 1) document changes in the fishery; 2) to determine if problems exist in the fishery; 3) to examine solutions to existing or impending problems; and 4) to develop recommendations for management action by the Council.

Management of the bottomfish populations is needed for several reasons. First, the bottomfish fishery is often a mainstay of the small-scale developing fisheries of the western Pacific region. Depending on location, boats engaged in commercial bottomfishing sometimes represent the majority of commercial fishing enterprises in these areas and are important to the local economies. For many fishing vessels, bottomfishing makes the difference between profitable and unprofitable operation. Second, bottomfish stocks are highly susceptible to rapid reductions in stock size due to overfishing. Bottomfish are also important species for the subsistence and recreational fisheries in these areas. Third, many bottomfish species have slow recruitment and growth rates. In Hawaii for instance, fishermen have noted that after catch rates of an opakapaka stock are reduced to a low level, it may take three years for that stock to increase to where it again becomes economically feasible to commercially exploit it. If management of bottomfish is postponed until stocks are severely reduced, it may take many years before this resource can again be commercially utilized. The FMP specifies objectives for managing the bottomfish fisheries; this 1987 annual report considers how well these objectives are being met.

The 1987 Report

Report Format. This report is written in the same basic format as the first annual report presented for the 1986 calendar year. The report is presented this way for the following reasons: 1) the FMP requires that specific information is needed to effectively manage bottomfish resources and therefore needs to be included in the yearly review; 2) standardization of the reports makes it easier to make comparisons between different years or geographic areas. Once information is standardized, the management of bottomfish resources across the western Pacific will be better accomplished.

Unlike last year's report, the 1987 report does not include the original BPMT modules (reports) as appendices. Instead, sources are listed for the original data (at the end of each geographic area), and interested readers are referred to these reports.

The following outline is used to present information for each area within the western Pacific region that is discussed in this report.

I. STATUS OF THE FISHERY

- A. Overview
- B. Total Landings and Trends
  1. Total Pounds Landed
  2. Bottomfish Catch Compared to Other Fisheries
- C. Revenue and Other Economic Indicators
- D. Fishing Effort
  1. Fleet Dynamics
  2. Number of Trips and CPUE
- E. Characteristics of the Catch
  1. Geographical and Seasonal Variations
  2. Species Composition
- F. Biological Assessment of the Landings
  1. Maximum Sustainable Yield (MSY)
  2. Size-Frequency Data by Species
- G. Summary Table of Fishery Status

II. RECENT RESEARCH

III. HABITAT CONDITIONS AND RECENT ALTERATIONS

IV. ENFORCEMENT ACTIVITIES AND PROBLEMS

V. NMFS ADMINISTRATIVE ACTIONS

VI. STATE/TERRITORY MANAGEMENT ACTIONS

VII. COUNCIL ACTIONS

A. Assessment of Need for Council Action
B. Recommendations for Council Action
C. Estimated Impacts of Recommended Action

Bottomfish Names and Other Terms Used. Bottomfish species within this management region are usually caught with deep-sea handline gear. Snappers, jacks, groupers and emperorfishes which inhabit submarine banks and slopes to 200 fathoms deep are the most important bottomfish to handline fishermen. The Hawaiian common name is used for the bottomfish species within this report, with the exception of onaga, gindai, and butaguchi which are Japanese names. The following is a list of principle species and the abbreviated names which may appear in the report.

Common Name	Abbreviation	Scientific Name
Hapuupuu	(HAP)	Epinephelus quernus
Kahala	(KAH)	Seriola dumerili
Kalekale	(KAL)	Pristipomoides sieboldii
Opakapaka	(OPA)	Pristipomoides filamentosis
Uku	(UKU)	Aprion virescens
Ehu	(EHU)	Etelis carbunculus
Onaga	(ONA)	Etelis coruscans
Ulua	(ULU)	Caranx and Carangoides spp.
Lehi	(LEH)	Aphareus rutilans
Gindai	(GIN)	Pristipomoides zonatus
Taape	(TAA)	Lutjanus kasmira
Butaguchi	(BUT)	Pseudocaranx dentex
White/Black Ulua	(WHT)	Caranx ignobilis

MUS, FCZ, MFCMA? Please refer to the "Glossary of Terms" in the back (Appendix B) for definitions of these acronyms and other terms used in the report.

Sources and Scope of Information. The information in this report came from a number of sources: the NMFS Office of Enforcement; the NMFS Southwest Fisheries Center Honolulu Laboratory (HL); the NMFS Southwest Region Western Pacific Program Office; the State of Hawaii Division of Aquatic Resources (HDAR); the American Samoa Department of Marine and Wildlife Resources (DMWR); the Commonwealth of the Northern Mariana Islands (CNMI) Division of Fish and Wildlife (DFW); and the Guam Division of Aquatic and Wildlife Resources (DAWR). The information provided was originally obtained to suit the individual

agency's needs; therefore some differences are inevitable in this report with respect to the presentation and content of information from these different agencies.

It should be noted that this report includes information on commercial landings only (with the exception of Guam), and that the recreational (non-market) value of bottomfish landings in the western Pacific region is also very significant. For example, the proportion of the total Main Hawaiian Islands' bottomfish landings attributed to the recreational component of the fishery has increased considerably in recent years. The National Marine Recreational Fishing Survey indicated that over 200,000 pounds of opakapaka and related species were caught in 1981 by recreational fishermen in Hawaii (NMFS, Honolulu Laboratory, unpublished data). It has also been estimated that 50% of the offshore fish catch on Guam is recreational in nature (K. E. Knudson, Contract WPC 0983 Progress Report, 6/5/84). Thus, it is clear that recreational bottomfish landings are an important component in the fishery. The Council is presently in the process of designing a survey to estimate the total recreational and small scale commercial catch in Hawaii. The survey will be fielded by HDAR. By combining recreational and commercial harvest statistics, the status of the western Pacific bottomfish fishery will be better understood. An understanding of both recreational and commercial components of the fishery will enable this important resource to be managed in a more sustainable fashion and with greater certainty.

BOTTOMFISH PLAN MONITORING TEAM RECOMMENDATIONS FOR COUNCIL ACTION

The following recommendations were agreed to by the Bottomfish Plan Monitoring Team (BPMT) as important for Council consideration. The recommendations were made by BPMT members acting as individuals and not as representatives of their respective agencies.

1. Joint international management of the seamount groundfish fishery.

2. Consideration of size limits in the Hawaiian islands bottomfish fishery.

3. Presentations to the Council of technical aspects in Plan Monitoring Team reports and/or other related scientific studies.

4. Resolution of disparities in Hawaii bottomfish data bases.

5. Participation of scientists from American Samoa, Guam, and the Northern Mariana Islands in Plan Monitoring Team meetings.

6. Expansion of data gathering programs in Guam and the Northern Mariana Islands to include more sites.

7. Improved biological statistics for bottomfish stocks in American Samoa, Guam, and the Northern Mariana Islands.

8. Continued collaboration between NMFS and the American Samoa Department of Marine and Wildlife Resources on joint assessment of bottomfish stocks in American Samoa.

These recommendations are explained on the following pages.

BOTTOMFISH BEING UNLOADED AT THE UNITED FISHING AGENCY,
HONOLULU, HI.

DESCRIPTION AND EXPLANATION OF BPMT RECOMMENDATIONS

1. Joint international management of the seamount groundfish fishery.

The fishing moratorium on the Hancock Seamounts was an attempt to preserve a brood stock, but the closure has been in effect for nearly four years and no sustained increase in recruitment has occurred. The problem is that the progeny of Hancock Seamount armorhead probably commingle during their juvenile phase with the young armorhead from other seamounts and that recruitment of an individual to a particular seamount is a random event unrelated to the seamount of origin. Since only ten percent of the armorhead stock is within the U.S. EEZ, the moratorium is unlikely to provide sufficient protection of a spawning stock to allow sustained future increases in abundance. The BPMT believes that efforts toward joint international management of the seamount fisheries for pelagic armorhead are essential for an increase in abundance on the Hancock Seamounts. Because armorhead have variable recruitment and high mortality, armorhead fisheries are inherently focused on recruiting fish and successful management strategies must therefore deal with preserving sufficient brood stock. The Council can take the lead in encouraging this kind of international cooperation.

2. Consideration of size limits in the Hawaiian islands bottomfish fishery.

The BPMT reviewed the analyses presented in "A Biological Assessment of Hawaiian Bottomfish Stocks, 1984-87" by Ralston and Kawamoto (SWFC Administrative Report H-88-8) and was troubled by the pervasive harvest of undersized, juvenile bottomfish in the Main Hawaiian Islands. The small size at entry to the fishery of opakapaka, onaga, ehu, and white ulua was particularly disturbing. Based on this clear warning sign of overfishing, the BPMT recommends that the Council investigate the desirability and pursue the implementation of meaningful size limits on the commercial sale of bottomfish that are caught in Hawaiian waters. Due to transboundary jurisdiction over the bottomfish resource, especially in the Main Hawaiian Islands, such action must be carried out in close cooperation with the State of Hawaii.

3. Presentations to the Council of technical aspects in Plan Monitoring Team reports and/or other related scientific studies.

The team recommends that the Council continue its practice of inviting the scientists to present their studies to the Council at a Council meeting.

4. Resolution of disparities in Hawaii bottomfish data bases.

There is significant divergence between the HDAR catch statistics for NWHI bottomfish and the NMFS Honolulu Lab monitoring program of landings at wholesale markets. It is evident that NWHI bottomfish catches are significantly under-reported to the State. It is recommended that the Council establish a task force (composed of NMFS, HDAR, Council personnel and NWHI bottomfish fishermen) whose task would be to help resolve the data disparity problem, and to recommend the best means of data collection which would be sufficient for stock assessment and other plan monitoring purposes.

5. Participation of scientists from American Samoa, Guam, and the CNMI in Plan Monitoring Team meetings.

The problems of the fisheries for bottomfish in Hawaii have received the most attention from the BPMT to date because the problems have been most intense in Hawaii. The BPMT now expects to devote more attention to the bottomfish fisheries in American Samoa, Guam, and the CNMI and wishes to have a scientist from each of these areas named to the BPMT. Participation of scientists from these areas would be particularly helpful in evaluating information on the status of the fisheries in these locations. The annual review of the fisheries is the most important function of the Plan Monitoring Team. We recommend that representatives from American Samoa, Guam, and the CNMI be named to the BPMT as soon as possible. The team also recommends that the annual review for both the bottomfish and pelagic species plan be held during the same week should the same scientists be named to the Pelagics Plan Monitoring Team.

6. Expansion of data gathering programs in Guam and the Northern Mariana Islands to include more sites.

Although substantial progress has been made in collecting data from each of these island areas, greater breadth of coverage should be encouraged. The BPMT recommends expanding the existing data gathering programs designed to intercept commercial landings to include markets on Tinian and Rota in the CNMI and to include more of the small wholesale/retail outlets (e.g., hotels) in Guam. Increased coverage of these market sectors would be beneficial to the team's ability to better understand trends in the bottomfish fisheries of these two regions.

7. Improved biological statistics for bottomfish stocks in American Samoa, Guam, and the Northern Mariana Islands.

   Better species identification and acquisition of extensive size-frequency data is especially important for biological assessment in each of these island areas. Further work to improve fishing effort statistics and information concerning the location of catch are highly desirable and should be encouraged.

8. Continued collaboration between the American Samoa Department of Marine and Wildlife Resources and NMFS on joint assessment of bottomfish stocks in American Samoa.

   The BPMT feels the recent history of the bottomfish fishery in American Samoa needs to be understood more fully because of its apparent boom-bust cycles. The current collaborative research by the American Samoa Department of Marine and Wildlife Resources and the NMFS Honolulu Laboratory on the status of bottomfish stocks in American Samoa is important to either substantiate or disprove perceived problems in the fishery. Particular attention should be devoted to the susceptibility of localized areas of productive bottomfish habitat (e.g., pinnacles and small banks) to be easily fished out.

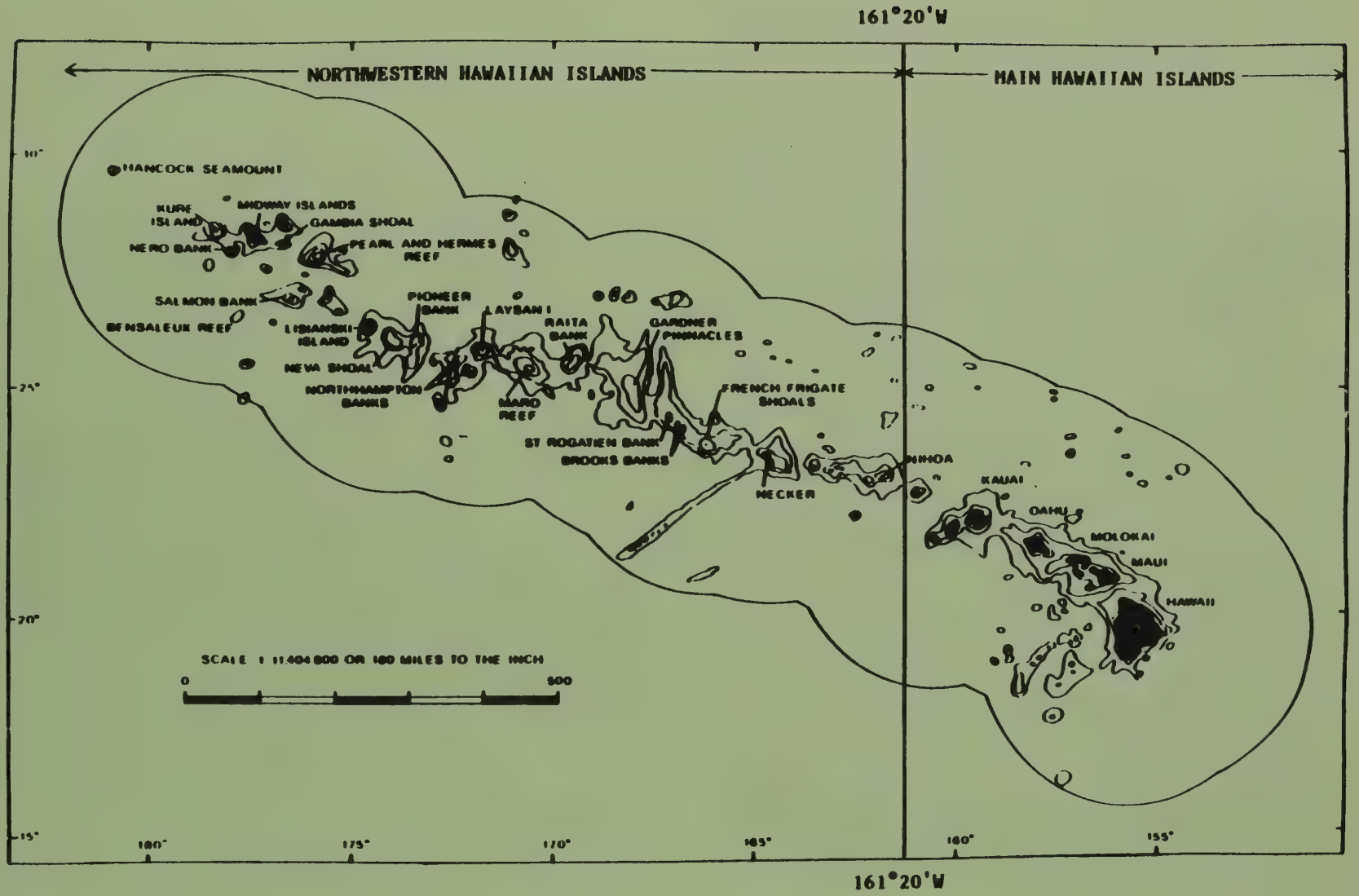


Figure 2. U.S. EEZ around the Hawaiian Archipelago and the dividing line separating the main Hawaiian Islands from the Northwestern Hawaiian Islands.

HANCOCK SEAMOUNTS

Overview

Hancock Seamounts (Figure 2), located northwest of the Northwestern Hawaiian Islands, once supported a full-scale armorhead commercial fishery. The fishery had a pronounced effect on the armorhead stocks, resulting in a moratorium on all armorhead commercial fishing activities in the area. Because of the continued interest and research on these stocks, a detailed account of the background of this fishery and present assessment of the stock is included this year in the annual report. All information presented here (with the exception of "Recommendations for Council Action") is from the NMFS Honolulu Laboratory (HL), (see Somerton 1988). This section will not follow the format outline for other geographic areas because the content differs.

Background of the Fishery Decline

The trawl fishery for pelagic armorhead, Pseudopentaceros wheeleri, on the Mid-Pacific Seamounts began with an exploratory venture by the Soviets in 1967. This early effort was expanded, and by 1972, the armorhead stock supported a full-scale commercial fishery, which included both Soviet and Japanese vessels. The fishery soon had a pronounced effect on the armorhead stocks, as evidenced by the Japanese trawlers' catch rates, which plummeted on the Hancock Seamounts from nearly 80 metric tons per hour (t/h) in 1972 to less than one t/h in 1978 and remained at less than one t/h through 1984 (Figure 3A). This 100-fold decrease in catch per unit effort (CPUE) indicated that the armorhead stock was severely stressed and prompted the Council to establish a six year moratorium, beginning in 1986, on all commercial fishing activities for armorhead within the U.S. Exclusive Economic Zone (EEZ) surrounding the Hancock Seamounts.

Summary of Recent Research

With the termination of the fishery, the Japanese fishery CPUE records on the Hancock Seamounts were no longer available, and the continued monitoring of the armorhead stock required an ongoing research stock assessment program. The NMFS HL had conducted fishery research on Hancock Seamounts since 1976, but in 1985 initiated research using standardized assessment techniques to collect a "time series" of stock abundance indicators.

The HL assessed the relative abundance of pelagic armorhead by using bottom longlines during six research cruises to the Southeast Hancock Seamount between January 1985 and August 1987. The research showed that during this time period, the abundance

Figure 3A. Catch per hour of the Japanese trawlers fishing the Hancock Seamounts. Data for years up to 1981 were obtained in Uchida and Tagami (1984); data for subsequent years were compiled from U.S. foreign observer reports on file at the Honolulu Laboratory.

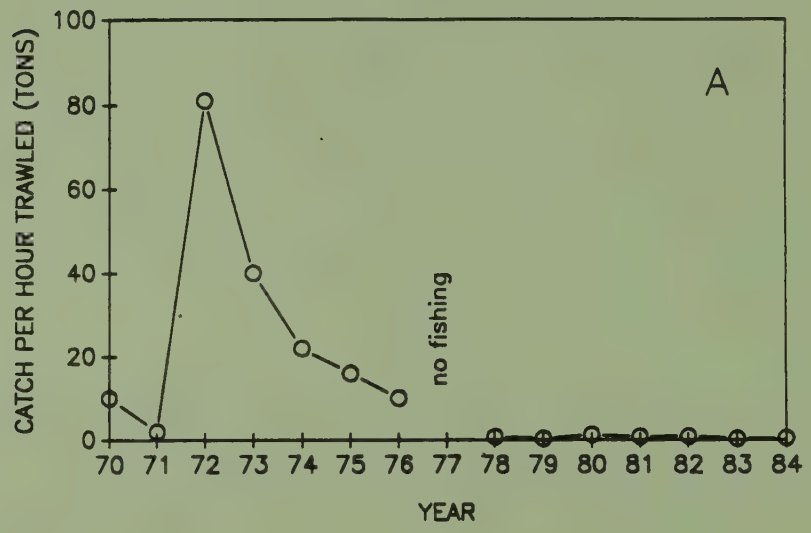
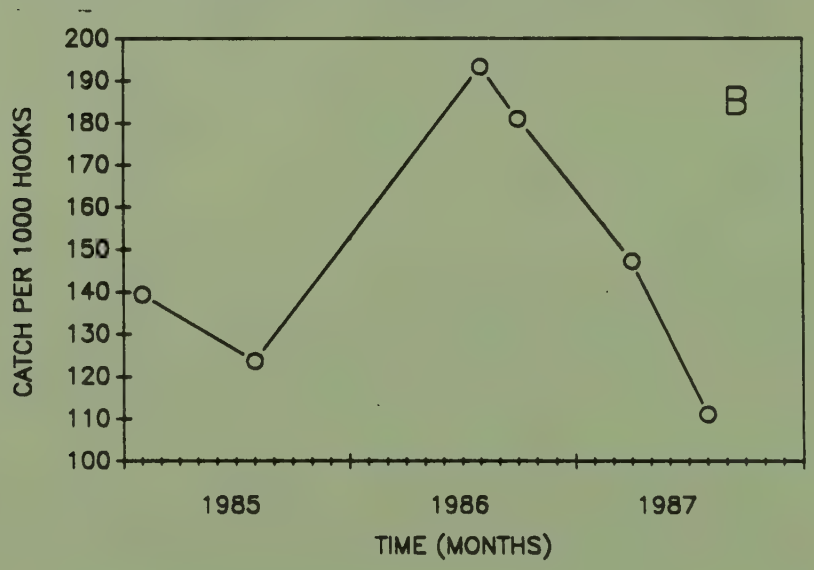


Figure 3B. Research longline catch per hook on Southeast Hancock Seamount for the six stock assessment cruises in 1985-87. (Somerton, 1988.)



of armorhead neither increased nor decreased continuously and instead showed large fluctuations; these fluctuations were due to the irregular recruitment of fish to the seamount and their subsequent rapid mortality. **Somerton concludes that the sustained low catch rates of the commercial trawl fishery since 1978 suggest that insufficient brood stock was maintained, and that the U.S. moratorium likely provided insufficient protection to rebuild the stock and some form of international management will be required.** The details of this research and reasons for this conclusion are presented below.

Details of Recent Research

The following presents in detail the NMFS research on relative abundance of pelagic armorhead, and is from "Assessment of the Stock Condition of Pelagic Armorhead on Southeast Hancock Seamount" (Somerton 1988).

Methods Used. It should be noted that current estimates of armorhead stock abundance cannot be compared to the historical Japanese CPUE record. This is because the new longline measures of stock abundance used for the time series since 1985 cannot be compared to (standardized against) Japanese trawl CPUE until fishing resumes.

The new time series was based on data obtained with Kali longlines (Shiota 1987), rather than bottom trawls, because the research vessel used by the Honolulu Laboratory is not well suited for trawling and because bottom trawls cannot sample armorhead inhabiting the steep sides of the seamount. Initially, we used the average catch per hook from the longlines as a measure of stock abundance, but after two cruises, it became clear that this measure could be biased because armorhead density was so high that, upon retrieval of the gear, few hooks remained unoccupied and baited. When such gear saturation occurs, catch per hook will cease to increase with armorhead abundance and will diminish with the catch of other species that compete with armorhead for hooks.

This problem led to a search for other ways of using longlines for stock assessment. One approach that showed promise was the use of small timers attached to each hook and activated when a fish strikes (Somerton et al. in review). The time to capture each fish on a longline can then be used to compute an index of abundance that, unlike CPUE, is unaffected by gear saturation and interspecific competition for hooks. Hook timers have been used on three of the longline stock assessment cruises, and a report dealing with this method of stock assessment is forthcoming (Somerton in prep.). Only the time series of armorhead catch per hook (CPUE) will be considered in this report.

During this recent study, the Southeast Hancock Seamount was sampled with longlines six times; the dates of the sampling and the effort, expressed as the number of hooks, are shown below:

Date	Hooks
2-26 February 1985	2,016
20 June-15 July 1985	2,718
11 August-8 September 1986	6,711
31 October-11 November 1986	2,948
12-27 April 1987	3,636
16-24 August 1987	4,534

Armorhead abundance was initially measured in terms of catch per 1,000 hooks, but this measure was modified to minimize two potential sources of bias. First, longlines with hook timers have a lower CPUE than longlines without timers when both types of gear are fished side by side (Somerton et al. in review). Hook timers were used on one-half of the hooks on the August and October 1986 cruises, on all of the hooks on the August 1987 cruise, and on none of the hooks on the remaining cruises; therefore, one of the gear types had to be adjusted for the difference in catchability to create a coherent time series. Because hook timers became the standard gear, the CPUE of hooks without timers was corrected for the presence of timers by using the CPUE ratio of the two gear types in the side-by-side comparisons.

Second, preliminary studies indicated that the depth distribution of armorhead might change over time and that such a change could produce variation in CPUE unrelated to the variation in armorhead abundance. This was minimized by separating the seamount into four depth strata, determining the CPUE within each stratum, then calculating the weighted average CPUE by using strata areas as the weighing factors.

Results and Discussion. The longline CPUE's for the first six stock assessment cruises to the Southeast Hancock Seamount are in Figure 3B. Over this three year period, the CPUE's have neither increased nor decreased continuously and instead have shown relatively large fluctuations; CPUE's increased by 60% from 1985 to 1986 and decreased by 27% from 1986 to 1987. This fluctuation has occurred because armorhead seemingly arrive at the seamounts sporadically and subsequently die rapidly.

Knowledge of several aspects of the life history of armorhead are crucial to understanding the evidence supporting the above explanation of armorhead fluctuations. Armorhead spend one and one-half to two and one-half years in the epipelagic zone of the northeast Pacific before returning as adults to the Mid-Pacific Seamounts where they spawn and remain until they die

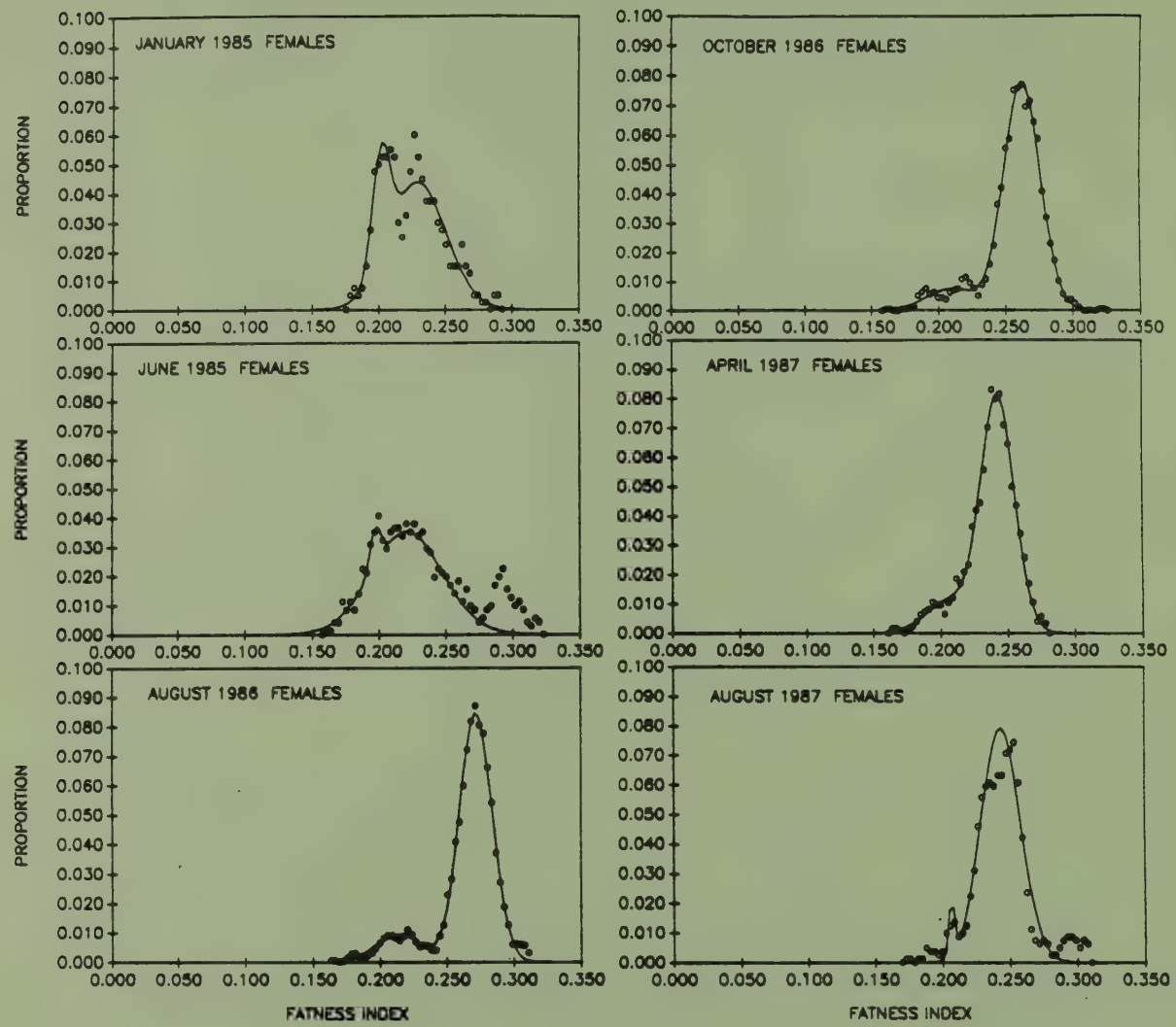
(Boehlert and Sasaki 1988; Humphreys et al. in press). When armorhead arrive at the seamounts; they are very fat, but because of the rigors of spawning and their apparent inability to obtain sufficient prey, they lose weight and eventually become quite emaciated. Since the beginning of the stock assessment cruises, this change in weight has been monitored with an index of fatness (body depth divided by length). If the fatness index (FI) is the same for all armorhead when they arrive at the seamounts and it decreases continuously and uniformly with time, then it can be used as a measure of time since arrival.

Frequency histograms of FI for the six stock assessment cruises (Figure 4) each have two or three distinct humps or modes. This pattern indicates that the arrival of armorhead at the Hancock Seamounts was concentrated over relatively short time periods that were followed by periods with little or no recruitment. These modes represent groups of fish, or cohorts, that can be followed from one histogram to the next as they progressively decrease in fatness. In January 1985, two modes were present, one at 0.19 FI and the other at 0.22 FI. In June 1985, the same two modes were present as well as a new mode at 0.29 FI. The histograms for the subsequent four cruises were each dominated by a single mode, which decreased from 0.27 FI in August 1986 to 0.24 in August 1987. The most likely interpretation of this pattern is that the fat fish first seen in June 1985 were the forerunners of a large recruitment of fish that apparently was completed by August 1986. Little or no recruitment occurred between October 1986 and August 1987. Comparing the recruitment pattern (Figure 4) to the longline CPUE's (Figure 3B), it is clear that armorhead abundance on the seamount increased markedly with the arrival of a single group of recruiting fish.

High recruitment variability is not the sole cause of the observed changes in armorhead abundance, because it does not explain the rapid decline in abundance after recruitment. The rapid decline is likely due to a high mortality rate. Mortality rate of armorhead was estimated by using the histograms of FI in conjunction with the longline CPUE's to follow the abundance of individual cohorts over time (Somerton and Kikkawa in press). For two cohorts, the estimate of annual natural mortality rate was about 0.70, which is an exceptionally high value for fish as large as armorhead (by comparison, the natural mortality rate of opakapaka is 0.31, less than one-half as high (Ralston and Kawamoto 1988). Without a fishery, roughly 50% of a recruited cohort will die each year, and few armorhead live beyond two years after recruitment.

If an armorhead fishery were to begin on the Hancock Seamounts, the already high variability in armorhead abundance would become higher still as fewer fish survived to their second year after recruitment. This means that the armorhead fishery is inherently targeted on recruiting fish and that successful

Figure 4. Frequency histograms of fatness index for female armorhead: 1985-87. (Somerton, 1988.)



management strategies must deal with the problem of preserving sufficient brood stock. The fishing moratorium on the Hancock Seamounts was an attempt to preserve a brood stock, but fishing has not occurred for nearly four years, and no sustained increase in recruitment has occurred. One problem is that all available evidence (Borets 1979) indicates that the progeny of Hancock Seamount armorhead commingle during their juvenile phase with the young armorhead from other seamounts and that recruitment of an individual to a particular seamount is probably a random event unrelated to the seamount of its origin. Considering that, historically, only 10% of the armorhead stock occurred within the U.S. Exclusive Economic Zone, the moratorium likely is insufficient protection to rebuild the stock, and some form of international management will be required.

Recommendations for Council Action

A complete list of BPMT recommendations for the western Pacific region was presented earlier in the front of this report. The BPMT has recommended the following in regard to Hancock Seamounts:

Joint international management of the seamount groundfish fishery. The fishing moratorium on the Hancock Seamounts was an attempt to preserve a brood stock, but the closure has been in effect for nearly four years and no sustained increase in recruitment has occurred. The problem is that the progeny of Hancock Seamount armorhead probably commingle during their juvenile phase with the young armorhead from other seamounts and that recruitment of an individual to a particular seamount is a random event unrelated to the seamount of origin. Since only 10% of the armorhead stock is within the U.S. EEZ, the moratorium is unlikely to provide sufficient protection of a spawning stock to allow sustained future increases in abundance. The BPMT believes that efforts toward joint international management of the seamount fisheries for pelagic armorhead are essential for an increase in abundance on the Hancock Seamounts. Because armorhead have variable recruitment and high mortality, armorhead fisheries are inherently focused on recruiting fish and successful management strategies must therefore deal with preserving sufficient brood stock. The Council can take the lead in encouraging this kind of international cooperation.

HAWAIIAN ISLANDS

The State of Hawaii is usually envisioned as a chain of eight high volcanic islands (Oahu, Kauai, Niihau, Molokai, Lanai, Maui, Kahoolawe, and Hawaii), but it actually extends for hundreds of miles to the northwest as a chain of reefs, islands and banks. The Hawaiian bottomfish fisheries represents two distinct fishing regions: the Main Hawaiian Islands (MHI), and the Northwestern Hawaiian Islands (NWHI) (Figure 2).

Fisheries data covering the Hawaiian Islands comes from two sources: the State of Hawaii Division of Aquatic Resources (HDAR), and the National Marine Fisheries Service (NMFS) Honolulu Laboratory (HL). There frequently are large differences between HDAR and NMFS harvest estimates. For example, Figure 5 shows two estimates of Hawaii's bottomfish landings 1984-1987, one by HDAR and one by NMFS. The NMFS estimates bottomfish landings increased in 1987, whereas HDAR data suggest they decreased; in addition, HDAR estimates over the years are consistently lower. These differences occur because the two agencies use different methods to obtain and analyze their data.

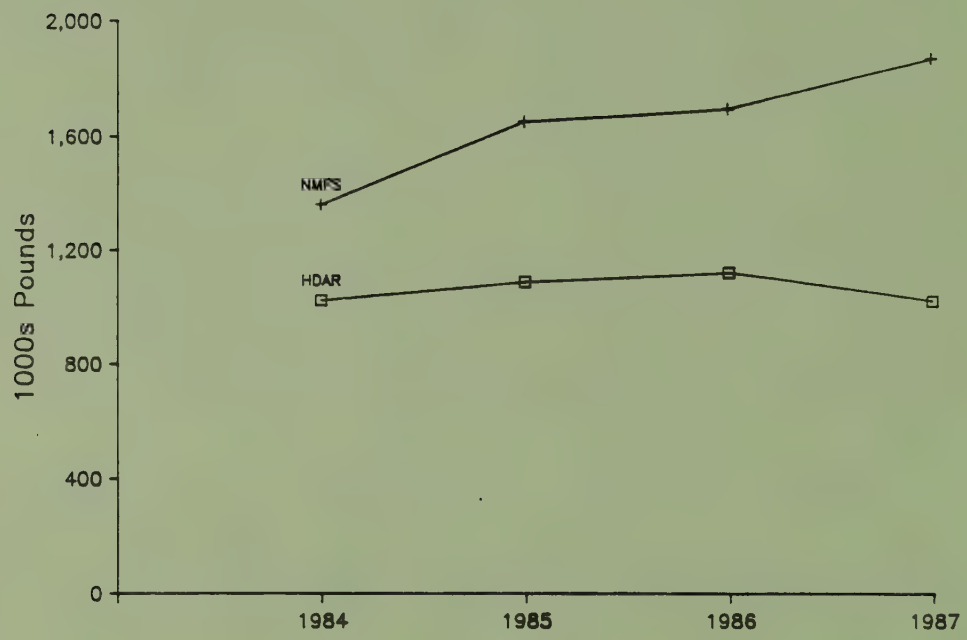
HDAR obtains their data directly from the fisherman. Fish catch data are reported by licensed commercial fishermen to HDAR on the C-3 form (Appendix C) on a monthly basis. This form lists species, days fished, areas fished, port of landing, number, pounds caught and sold, and price received.

NMFS obtains their data from the market, through the wholesale market monitoring program conducted by the Fishery Management Research Program of the HL.

Both the HDAR and NMFS systems have limitations. The HDAR data system under-counts landings in Hawaii because of under-reporting by fishermen. It also does not have zero-catch trip data, thus estimates of catch per unit effort (CPUE) are higher than they really are. However, relative CPUE, such as pounds caught per reported day or trip are used as indicators of fishery performance; relative CPUE is calculated by HDAR by dividing the total pounds by the total number of records on which catches were reported, for each species by zone. The NMFS data system is limited to a "sample" of landings, which must then be extrapolated to derive estimates of total landings. NMFS data presented here is scaled to an estimate of total market quantities. (The "scaling factors" are confidential because of the small number of sources from which NMFS's samples are taken.)

The problem of two sets of different data makes it difficult for BPMT members, as well as other readers of this report, to analyze the current status of Hawaiian bottomfish. The BPMT has recommended a resolution of the disparities in the Hawaiian

Figure 5. Two estimates of Hawaii's bottomfish landings: 1984-87. (Pooley and Kawamoto, 1988.)



fisheries data (see section on Recommendations for Council Action) but until this problem is resolved, both the HDAR and NMFS data will be presented where appropriate, and the reader is cautioned about the existence of two different data sets.

I. STATUS OF THE FISHERY

A. Overview

Hawaii's 1987 bottomfish landings totaled 1,081,061 pounds according to HDAR and 1,869,000 pounds according to NMFS, resulting in revenues of $5.4 million (NWHI $2.3, MHI $3.1) according to NMFS. A total of 28 vessels fished for bottomfish in the NWHI, but only eight of these were fishing for bottomfish full-time. Opakapaka and onaga continued to comprise the largest percentage of total landings and revenue. **There is little biological evidence that the NWHI stocks are stressed, whereas there is evidence that four species (opakapaka, onaga, ehu, and white ulua) are being consistently harvested undersized (immature) in the MHI.**

B. Total Landings and Trends

1. Total Pounds Landed

Total pounds of bottomfish landings for 1987 as reported (by commercial fishermen) to HDAR is 1,081,061 pounds, down 4.7% from the 1986 total of 1,134,374 pounds. The total catch for MHI zone is 757,585 pounds (down 6.45% from 1986) and for the NWHI is 322,788 pounds (up 1.4% from 1986); the reported landings for other zones (not specified) is negligible, totalling 688 pounds.

The NMFS estimate for bottomfish landings in Hawaii during 1987 (based on market monitoring) is 1,869,000 pounds (Pooley and Kawamoto 1988). The NMFS estimates of recent trends for bottomfish sales in Hawaii (Table 1, Figure 5) show a significant increase in landings in Hawaii in 1987 and a 12.5% annual growth rate since 1984. All three segments of the Hawaii bottomfish market (landings from the NWHI and the MHI and imports) have grown over the past four years, according to NMFS.

The HDAR data on Hawaii landings (Table 2, Figure 5) show a peak in 1986, but the most dramatic growth occurred between 1974 and 1984 (17% annual growth rate). As mentioned earlier, the HDAR data (preliminary monthly reports) suggest a decline in Hawaii landings for 1987, whereas the NMFS wholesale market monitoring estimates show an increase.

Table 1. The NMFS estimate[a] of Hawaii bottomfish market volume, by source, 1984-87 (in thousands of pounds[b]). NWHI = Northwestern Hawaiian Islands; MHI = Main Hawaiian Islands. (Pooley and Kawamoto, 1988).

		SOURCE			
Year	Total	NWHI	MHI	Hawaii only	Imports[c]
1984	1,510	661	697	1,358	252
1985	1,913	922	727	1,649	264
1986	2,013	948	746	1,694	319
1987	2,353	1,017	852	1,869	484

[a]The NMFS estimates are based on market monitoring; data scaled to estimate of total market quantities.

[b]Values are reported in pounds, which is the industry standard in Hawaii. One pound equals 0.45 kg.

[c]Import data from NMFS Market News Service reports.

Note: Figures may differ from other reports because of rounding. Preliminary nature of some data, and reporting conventions. Table 1 differs from subsequent tables of NMFS estimates because of different reporting conventions for 1984 and 1985. The four years of data in Table 1 are reported on a consistent basis.

Table 2. Hawaii bottomfish landings, 1970-87, based on reported commercial landings of the Hawaii Division of Aquatic Resources (annual summaries). (Pooley and Kawamoto, 1988).

YEAR	POUNDS LANDED	REVENUE	PRICE[a]
1970	339,502	239,564	2.01
1971	406,006	310,021	2.09
1972	402,173	363,238	2.39
1973	446,139	413,523	2.35
1974	405,864	417,066	2.36
1975	555,255	591,645	2.24
1976	557,835	692,434	2.48
1977	560,447	762,327	2.58
1978	738,070	1,098,093	2.63
1979	692,430	1,120,363	2.57
1980	710,063	1,077,861	2.16
1981	637,841	1,253,469	2.53
1982	746,060	1,587,992	2.58
1983	880,169	1,956,060	2.62
1984	1,028,867	2,376,500	2.64
1985	1,079,619	2,646,412	2.65
1986	1,121,067	2,791,173	2.62
1987[b]	1,019,176	2,812,755	2.76

[a]Prices calculated from pounds caught (not pounds sold) and adjusted to current values with the 1987 Honolulu consumer price index.

[b]Preliminary data.

2. Bottomfish Catch Compared to Other Fisheries

Figure 6 compares the annual total catch of bottomfish to total catches of other fisheries in the Hawaiian Islands, as reported to HDAR. (The classification of fisheries follows Hamm and Kassman, 1986). Pelagic fisheries were the largest component, and the pelagic catch continued to increase in 1987. The HDAR estimate of total bottomfish catch decreased slightly, so the major decrease in reported landings took place in "Other" fisheries (Figure 6).

C. Revenue and Other Economic Indicators

According to NMFS data (Pooley and Kawamoto 1988), the economic value of Hawaii's bottomfish market has grown with landings over the past two years (1987 and 1986), both in terms of gross revenue and average prices received by fishermen (Tables 3 and 4). Although the value of the market has grown, annual revenue per active vessel has declined, (see discussion under "fleet dynamics" below).

Distribution of bottomfish sales by source is shown in Figure 7 for 1986 and 1987. The NWHI segment of the market has shown volume growth over the past four years. The price distribution between NWHI, MHI, and imported fish is shown in Table 4, with quality premiums paid for MHI bottomfish. Prices rose by 13% on an average. Bottomfish landed from the MHI received 70% more per pound compared to NWHI bottomfish. Opakapaka and onaga received the highest price per pound. According to HDAR, these two species also accounted for over 68% of total 1987 Hawaiian bottomfish revenues (Table 5). Imports, with potentially 20% of the overall market, pose significant price competition to landings in Hawaii, especially for NWHI landings which have a shorter shelf life because of the much longer distances traveled by fishermen to and from fishing grounds. The price premiums shown for MHI bottomfish, despite their smaller average size (Ralston and Kawamoto 1988), continue to reward bottomfish fishermen in the MHI because bottomfish caught in the MHI are much fresher when they are landed.

The fresh fish market for bottomfish remained extremely strong (according to NMFS), but because of limited supply, exports of bottomfish did not match the growth in the tuna export market. Imports of bottomfish to Hawaii also were higher in 1987. The pattern of bottomfish imports to Hawaii over the past four years is shown in Table 6 and Figure 8. Imports now account for approximately 20% of the Hawaii market. There has been substantial growth (46% per annum growth rate) in total bottomfish imports from 1984 to 1987. Approximately 80% of the imports come from the tropical Pacific, with Fiji and Tonga being major supply areas. The remainder comes from Australia, Japan, New Zealand, and Taiwan and may not represent the same market

Figure 6. Total annual reported catch for Hawaii's fisheries (HDAR, 1988).

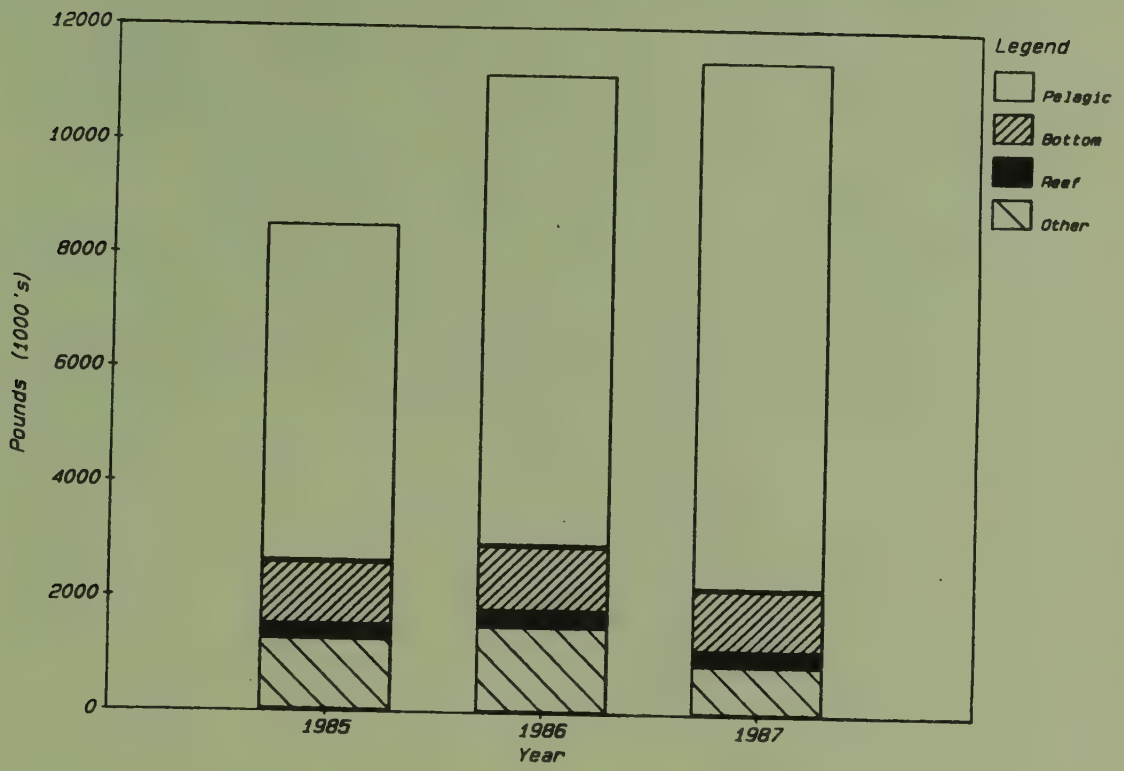


Table 3. Hawaii bottomfish market revenue: 1986-87. The data are from the market monitoring program of NMFS and are scaled to estimate the total market. (Pooley and Kawamoto, 1988).

SOURCE	1987	1986
	(In Million $)	
Northwestern Hawaiian Islands	$2.3	$2.1
Main Hawaiian Islands	3.1	2.3
Hawaii Subtotal	$5.4	$4.4
Imports[a]	1.3	1.3
Total	$6.7	$5.7

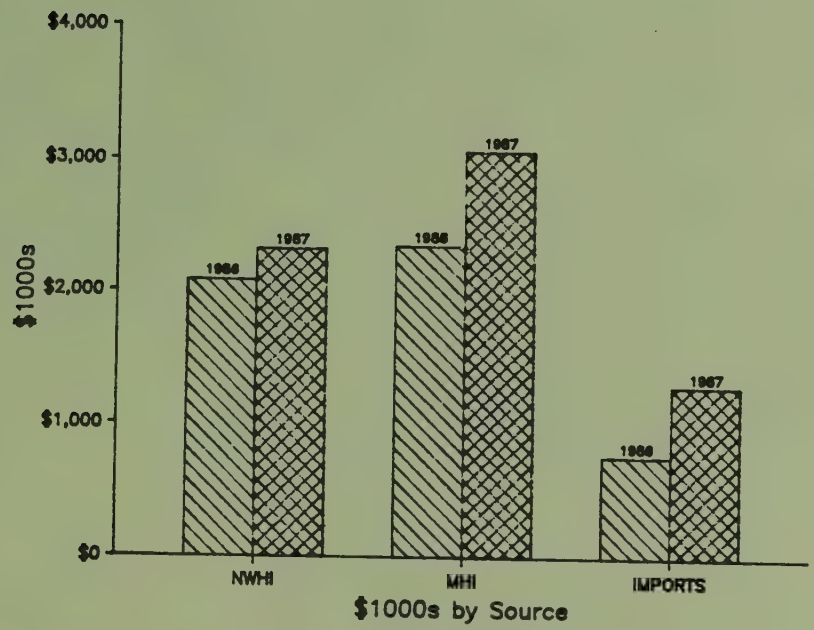
[a]The NMFS's market monitoring prices applied to NMFS Market News Service Reports.

Table 4. Price (per pound) distribution by species and product source for the Hawaii bottomfish market: 1986-87. NWHI = Northwestern Hawaiian Islands; MHI = Main Hawaiian Islands. The data are from the market monitoring program of NMFS and the data are scaled to estimate the total market. (Pooley and Kawamoto, 1988).

	1986			1987		
	Market[a]	NWHI	MHI	Market[a]	NWHI	MHI
Opakapaka	$3.41	$3.20	$3.78	$3.56	$3.27	$3.97
Onaga	3.93	3.13	4.39	4.70	3.24	5.12
Ehu	2.56	2.14	3.32	3.17	2.36	3.75
Hapuupuu	1.61	1.56	2.23	1.93	1.87	2.74
Butaguchi (Ulua)	1.32	1.07	2.00	1.19	1.16	2.51
Other	2.43	2.39	2.26	2.42	2.11	2.55
Imports	2.38	.00	.00	2.67	.00	.00
Hawaii Only	2.83	.00	.00	3.10	.00	.00
Total	2.78			3.02		

[a]Market prices includes average prices from NWHI, MHI, and imports.

Figure 7. Hawaii bottomfish market sales by source: 1986-87. NWHI - Northwestern Hawaiian Islands; MHI = Main Hawaiian Islands. (Pooley and Kawamoto, 1988).



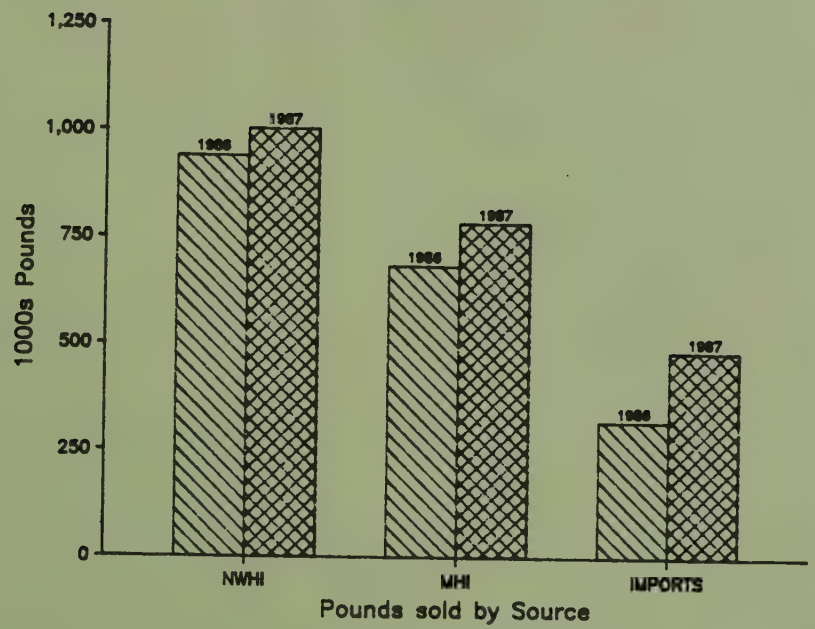


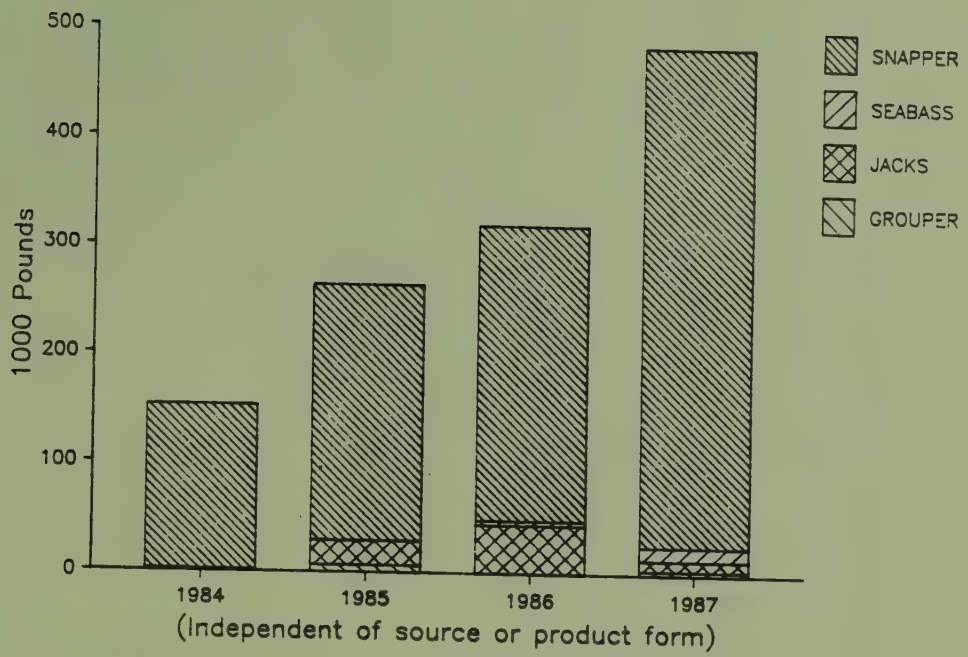
Table 5. Total Hawaiian bottomfish revenues (% by species) in 1986 and 1987. Data are based on HDAR calendar year summaries.

Species	% of Total Revenue: 1986	1987
Opakapaka	.328	.418
Onaga	.308	.270
Uku	.103	.058
Hapuupuu	.058	.047
Ehu	.057	.054
"Ulua"	.045	.042
Butaguchi	.028	.027
Lehi	.021	.033
Kalekale	.016	.019
Taape	.015	.016
White Ulua	.013	.010
Kahala	.004	.002
Gindai	.004	.004

Table 6. Bottomfish imports into Hawaii (in pounds as reported to Food and Drug Administration): 1984-87. Data were compiled from NMFS Market News Service reports, with an extrapolation made for incomplete 1987 figures. (Pooley and Kawamoto, 1988).

	1984	1985	1986	1987
Groupers	533	6,600	570	3,992
Jacks	1,102	22,301	44,047	9,144
Sea Bass	0	169	4,059	11,893
Snappers	50,814	234,609	270,408	446,610
Total	52,449	263,679	319,084	471,640

Figure 8. Hawaii bottomfish imports: 1984-87. Data are based on the NMFS's Market News Service reports from records of the U.S. Food and Drug Administration. (Pooley and Kawamoto, 1988).



niche as Hawaii and other tropical Pacific bottomfish do. Import data do not have prices; however, if we applied the (NMFS) monitoring program's average imported bottomfish price, ignoring species composition and product form, then the 1987 imports would be worth about $1.26 million.

No imports of snappers, groupers, or jacks were recorded from American Samoa, Guam, or the Commonwealth of the Northern Mariana Islands in 1987. Landings from American Samoa and Guam were recorded for previous years.

The import figures are derived from the NMFS Market News Service's annual summaries of fishery products imported to Hawaii. The data are compiled by the NMFS Western Pacific Program Office (WPPO) and are from the Food and Drug Administration (FDA) inspection program. These data provide a more complete species breakdown for Hawaii than do U.S. Customs data, but they are incomplete because only lots valued over $1,000 are monitored and because invoices for lots pulled for inspection are not available for WPPO recording. The data cover all sources outside the U.S. Customs area, including American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands. Furthermore, because of a minor sampling problem, annual totals for 1987 needed to be extrapolated. These summaries do not distinguish product form, whether round or fillet. However, in 1987, 94% of the snapper imported into Hawaii was in whole form (this does not include snapper brought to the State from the mainland United States). The data refer only to fresh/frozen imports and not to any processed products. Not all of the imported bottomfish remain in Hawaii; some may be reexported to the mainland United States by local wholesalers and brokers.

D. Fishing Effort

1. Fleet Dynamics

Although the recorded number of "active" vessels in the Northwestern Hawaiian Islands (NWHI) bottomfish fishery continued to grow in 1987 (from 24 vessels in 1986 to 28 in 1987), by year's end, only eight vessels were fishing full-time for bottomfish. The other vessels that landed NWHI bottomfish were engaged in other fisheries as their primary target. The multi-fishery fleet, which includes some tuna longliners and albacore trollers, accounted for seven of the 20 other vessels. Another seven vessels dropped out of the NWHI bottomfish fishery entirely. Switching to another fishery, primarily lobster trapping, accounted for three more vessels. Two vessels continued to target bottomfish on a part-time basis, and one vessel sank. (Pooley and Kawamoto 1988).

The motivations behind the decrease in the number of full-time vessels in the NWHI bottomfish fishery are diverse, but two of the main reasons appear to be that concentrations of bottomfish are more difficult to locate and other fisheries have become much more lucrative. Although revenue per trip increased in 1987 to $17,500, annual revenue per active vessel declined ($83,600) because most vessels made fewer trips in the bottomfish fishery. Many vessels switched to longline tuna fishing in 1987 as market prices for Hawaii's longline-caught tuna skyrocketed as exports to Japan were reinstigated. This, combined with good conditions in the established spiny and slipper lobster fishery and the promising developments in the deep-sea shrimp fishery, has posed a strong incentive for traditional bottomfish captains to shift some or all of their effort to these alternative fisheries. (Pooley and Kawamoto 1988).

2. Number of Trips and CPUE

NMFS. Fishing effort (trips) and CPUE (pounds per trip) were calculated for the NWHI fishery (Table 7) by Ralston and Kawamoto (1988). Results show that the total number of bottomfish fishing trips to the NWHI in 1987 (f = 134) was less than in 1986 (f = 163). A better measure of fishing effort, however, is the number of "effective" trips; i.e., those trips wherein at least 1,000 pounds of bottomfish are landed. Using this measure, fishing effort appeared to decline 15% in 1986-87, going from 139 to 118 trips. These trips were completed by 26 vessels in 1988, compared with only 22 the year before. Thus, the effective number of trips per vessel declined from 6.3 (in 1986) to 4.5 (in 1987) despite a net increase of boats in the fishery (+4).

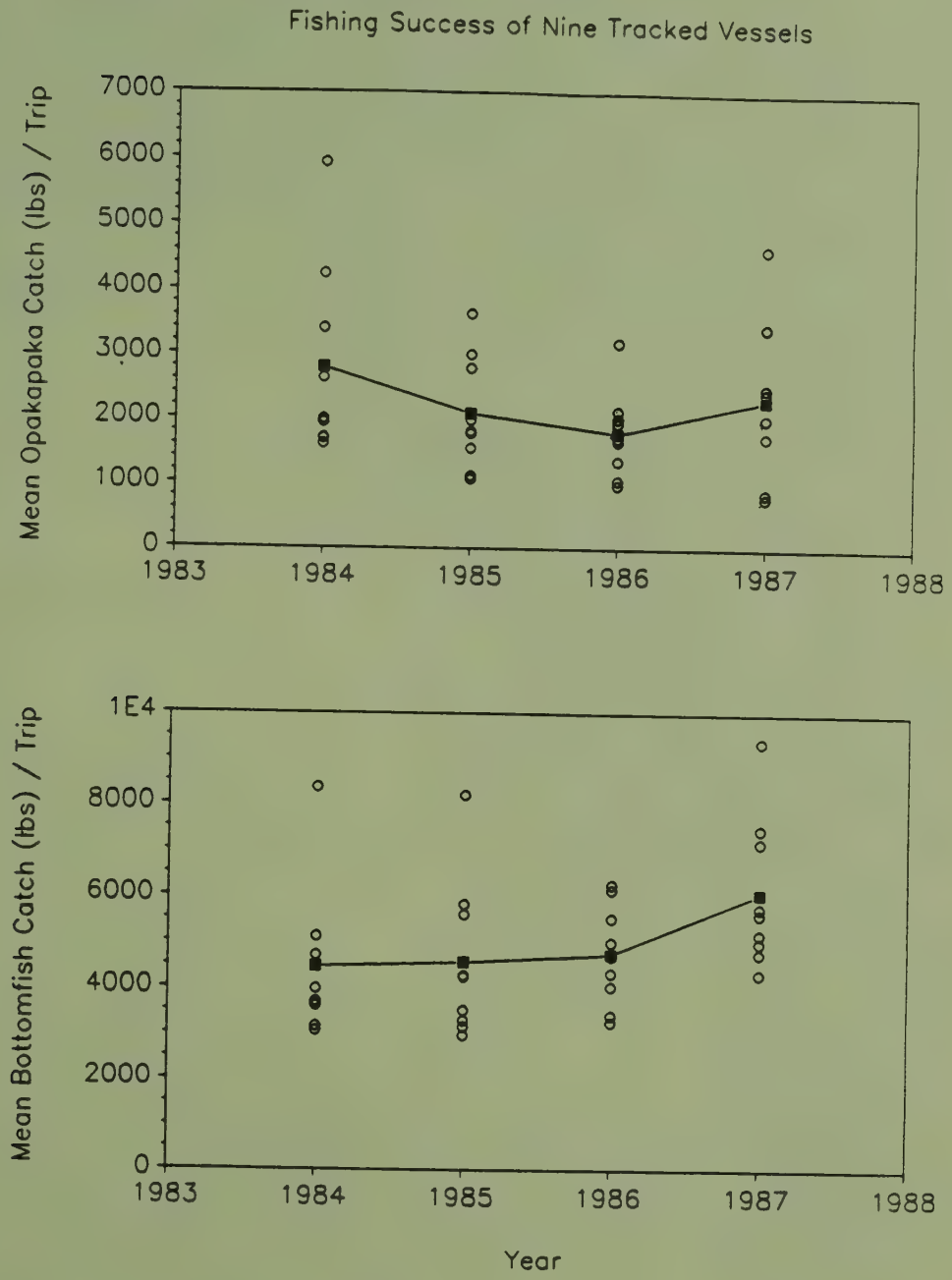
Overall CPUE statistics for each of the four years indicate a general increase in the catch per trip (see Ralston and Kawamoto 1987), going from 4,100 pound/trip in 1984 to 6,200 pound/trip in 1987. These figures are somewhat deceiving though, because a different group of boats fished in the two years. Because of the entry and exit of boats to the fishery every year, comparisons of fleet-wide CPUE statistics must be compared with caution.

In order to more effectively compare annual CPUE, only those nine fishing vessels that have been in the fishery all four years (Vessels J-R, in Table 7) were included in calculations of CPUE statistics. The results (Figure 9) of tracking the performance of these vessels over four years provide a statistically valid indication of conditions within the fishery. Catch rates of opakapaka in 1987 reversed a declining trend, rising for the first time since data collection began. The catch rate of all bottomfish species combined (lower panel of Figure 9) also rose appreciably during 1986-87, continuing the rising trend from previous years.

Table 7. Effective effort (number of 1,000 pound trips) and catch per unit effort (CPUE) (pounds of bottomfish per trip) for the NWHI bottomfish fishery: 1984-87. (Ralston and Kawamoto, 1988).

	1984		1985		1986		1987	
Vessel	Trips	CPUE	Trips	CPUE	Trips	CPUE	Trips	CPUE
A	2	6,105	--	--	--	--	--	--
B	1	1,044	--	--	--	--	--	--
C	7	2,650	--	--	--	--	--	--
D	10	10,584	--	--	--	--	1	--
E	2	2,744	--	--	--	--	1	2,299
F	4	1,314	1	2,058	--	--	--	--
G	4	3,392	3	4,099	--	--	--	--
H	8	4,031	6	3,201	--	--	--	--
I	3	1,786	4	1,600	1	1,207	--	--
J	5	3,970	11	4,267	8	4,337	11	5,613
K	12	8,351	13	8,194	11	6,141	4	7,178
L	12	4,691	5	3,520	2	3,407	3	4,317
M	6	5,106	10	5,595	8	3,255	7	4,760
N	3	4,461	3	2,963	4	4,998	5	5,182
O	10	3,058	15	4,241	11	4,037	11	5,759
P	5	3,684	4	3,295	13	4,698	3	7,469
Q	4	3,152	16	5,811	15	5,523	16	9,379
R	9	3,613	5	3,160	8	6,254	6	4,998
S	--	--	4	6,926	5	7,306	3	9,769
T	--	--	1	3,338	9	8,339	6	13,564
U	--	--	1	3,984	3	1,152	2	5,295
V	--	--	1	2,339	2	1,196	3	6,868
W	--	--	11	8,805	11	11,091	11	12,035
X	--	--	13	7,278	7	6,086	2	6,712
Y	--	--	6	1,605	6	1,877	--	--
Z	--	--	1	5,527	--	--	1	4,545
AA	--	--	--	--	3	11,140	3	14,336
BB	--	--	--	--	1	1,152	2	3,612
CC	--	--	--	--	3	3,705	2	5,914
DD	--	--	--	--	7	1,498	2	1,629
EE	--	--	--	--	1	6,476	--	--
FF	--	--	--	--	--	--	3	3,360
GG	--	--	--	--	--	--	3	1,712
HH	--	--	--	--	--	--	3	2,961
II	--	--	--	--	--	--	4	5,535
Total	107	--	134	--	139	--	118	--

Figure 9. Catch rate statistics (opakapaka above and bottomfish below) for the nine NWHI vessels active during the 1984-87 period. Open circles are annual mean catch rates for individual vessels; closed square are the yearly group means. (Ralston and Kawamoto, 1988).



The following summary of the fishing activity of the bottomfish fleet in the NWHI, including Table 8, is from Pooley and Kawamoto (1988). Participation and operating rates were relatively the same in 1987 as in 1986. The average number of trips per vessel decreased from six in 1986 to four in 1987, but the low average number of trips is somewhat misleading. The number of vessels that made five or less trips was 21 or 75% of the fleet in 1987 compared to 12 vessels or "only" 50% of the fleet in 1986. Part-time vessels tended to take bottomfish fishing trips to the NWHI when tuna was in greatest supply and tuna prices were accordingly lower. The Council's limited entry plan (see Section V. NMFS ADMINISTRATIVE ACTIONS) also may have influenced some part-time bottomfish fishing vessels to take at least a few trips in order to meet proposed eligibility requirements for future participation.

HDAR. The estimated effort and relative CPUE in 1987 (for NWHI, MHI, Other=non-specified) are shown in Table 9. Since no zero-catch trip data are available in the catch report data base, true CPUE cannot be estimated. A relative index is given based on the pounds caught per record by species. The assumption is that each record represents one day's catch of one species. A total of 20,209 records of bottomfish were drawn from the HDAR data base. It is not known whether the "day" reported on the catch report corresponds to the day when a particular fish is caught or the day it is landed. Therefore, calculation of catch per trip is not yet possible from HDAR data. The relative CPUE reported here should be compared only to other HDAR estimates of relative CPUE calculated in similar fashion. Total catch and mean relative CPUE by zone for the years from 1977 to 1987 are summarized in Figure 10.

According to HDAR, the relative CPUE's for the NWHI were higher than for the MHI for all species, except kahala and taape, often by a factor of ten or larger. The difference is probably due to the higher abundance of these species in the NWHI and in targeting of different species.

E. Characteristics of the Catch

1. Geographical and Seasonal Variations

Total 1987 landings in pounds (HDAR data) are given by area and by species in Table 10. Data for 1985 and 1986 were reported earlier in the 1986 Bottomfish Annual Report. According to the HDAR data, the bottomfish fishery in the MHI landed 70.1% of the total landings in 1987, essentially unchanged from the previous two years. However, the NMFS estimates that the MHI accounted for less than 50% of the total landings, but is almost equivalent to that of the NWHI (Pooley and Kawamoto 1988). Total landings were highest in the late fall and winter (Figure 11), which likely partly reflects the market demand for red fish

Table 8. Fishing activity of the bottomfish fleet in the NWHI: 1986-87. (Pooley and Kawamoto, 1988).

	1986	1987
Vessels	28	24
Trips	134	163
Total days fished	938	978
Days fished/trip	7.0	6.0
Days traveled/trip	9.5	8.5
Days/trip	16.5	14.0
Catch/trip (Bottomfish MUS)	6,239	4,900
Revenue/trip	$17,462	$13,125
Trips/vessel	4.8	6.8
Revenue/vessel	$83,571	$87,500

Catch rates for 1987 have been looked at on a per trip basis (see above), but another way to examine catch is per day at sea. At the suggestion of a bottomfish fisherman (who is also a BPMT member), NMFS is starting to make some exploratory analysis of "catch per day at sea" for the following reasons. Using "catch per trip" may not show if total catch is declining, because the fisherman knows that he needs "x" number of pounds to make the trip economically successful so he fishes until he catches that amount. Throughout most of the years, the length of trips have increased (NWHI); by using "catch per day" the additional distances traveled would be reflected, whereas using only fishing days would bias the data because the fishermen are looking for areas of better catch rates and it would not take into account the additional distances traveled to look for fish. Fishing effort can be thought of as not only the amount of time the line and hooks are in the water, but also the time spent searching and traveling; this is the total trip effort. When it comes down to money it is the measure of the total catch value and total expense, and not just the expense while the lines are in the water.

Table 9. Total catch effort[a], and relative CPUE by species in 1987. (HDAR, 1988).

SPECIES	ZONE	CATCH LBS.	EFFORT	RELATIVE CPUE
Hapuupuu	Main Islands	12,816	466	27.5
Kahala	"	19,663	468	42.0
Kalekale	"	28,258	1,382	20.4
Opakapaka	"	267,416	4,269	62.6
Uku	"	54,371	1,244	43.7
Ehu	"	44,408	2,386	18.6
Onaga	"	165,833	2,896	57.3
"Ulua"	"	67,859	2,945	23.0
Lehi	"	37,160	1,195	31.1
Gindai	"	2,891	364	7.9
Taape	"	47,938	1,789	26.8
Butaguchi	"	1,630	90	18.1
White Ulua	"	7,342	148	49.6
Hapuupuu	NW Islands	58,651	87	674.2
Kalekale	"	1,244	35	35.5
Opakapaka	"	126,544	86	1,471.4
Uku	"	1,238	19	65.2
Ehu	"	8,611	61	141.2
Onaga	"	23,789	53	448.8
"Ulua"	"	15,019	80	187.7
Gindai	"	2,016	32	63.0
Taape	"	59	4	14.8
Butaguchi	"	74,061	76	974.5
White Ulua	"	11,556	17	679.8
Hapuupuu	Other	258	6	43.0
Kahala	"	18	1	18.0
Kalekale	"	13	1	13.0
Opakapaka	"	100	1	100.0
Ehu	"	7	1	7.0
Onaga	"	34	1	34.0
"Ulua"	"	232	5	46.4
Lehi	"	26	1	26.0

[a]Number of records a particular species was reported caught.

Figure 10. Relative CPUE by year and zone: 1977-87. (HDAR, 1988).

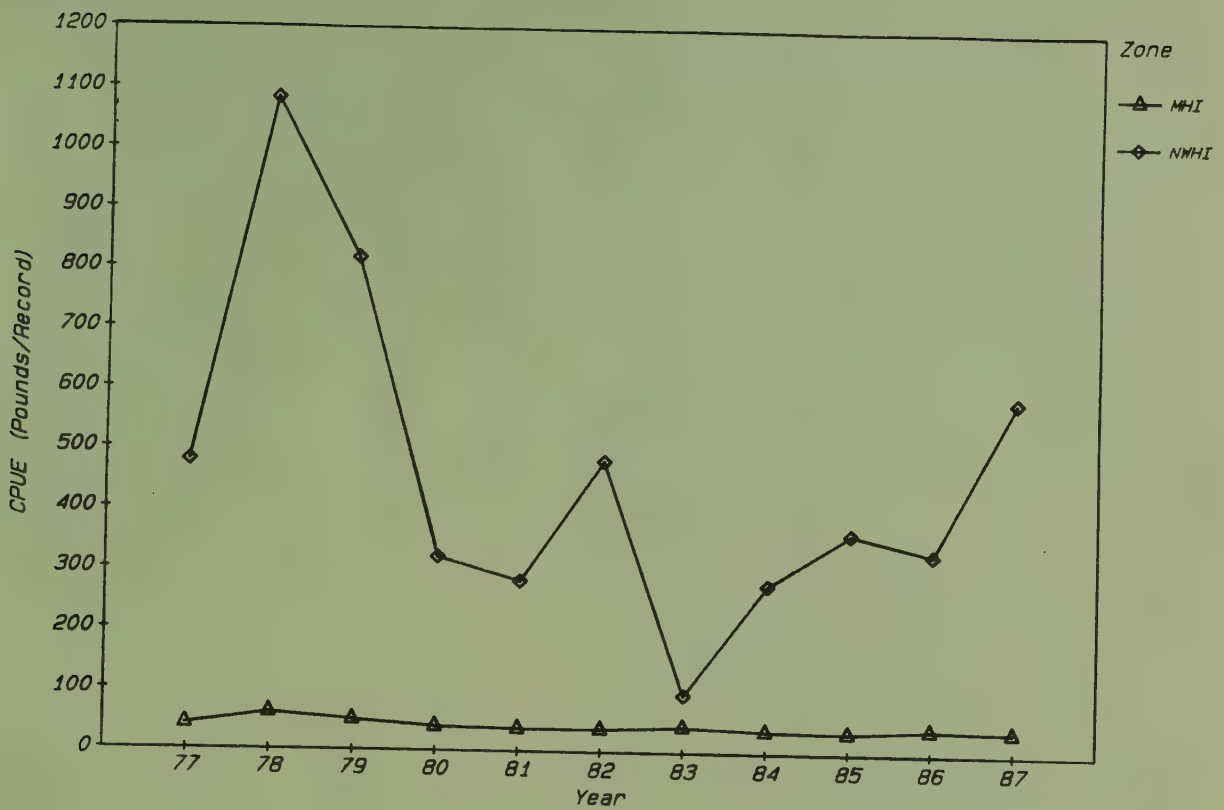


Table 10. 1987 total annual bottomfish landings by area and species (landings in pounds). (HDAR, 1988).

Area	HAP	KAH	KAL	OPA	UKU	EHU	ONA	ULUA	LEH	GIN	TAA	BUT	WHT
Hawaii	2765	13588	10549	94674	13274	16159	27611	16658	19315	1230	11421		1841
MLKM	3673	2563	11531	138137	19639	18832	100541	21152	16322	766	15838	398	1136
Oahu	679	630	2108	22335	3716	2839	15029	15053	1336	172	14085	875	4092
KNK	5699	2882	4070	12270	17742	6578	22652	14996	187	723	6594	357	273
MHI	12816	19663	28258	267416	54371	44408	165833	67859	37160	2891	47938	1630	7342
Nihoa	1171		160	645	642	451	574	468		38	25	1419	
Necker	1816		322	5841	160	261	1583	887		90	34	1931	616
Frigate	1799		230	11422	80	656	13766	81		76		4960	
Brooks	1618		124	10916	29	281	304	162		64		3307	42
Roga.	1201			1381			30					1431	
Gardner	1036			2927		49	760	597				1000	
Raita	11993		25	24224	64	1865	2040	1112		309		10928	3891
Maro	14117		139	44171	218	1491	398	1451		333		24670	3429
North.	3607		86	174		1441	2787	36		697		705	1570
Pioneer	7936		89	700		1363	622	59		346		2759	311
Lisi.	4446			11621	17	713	720	562				2436	1697
Midway	7911		69	12522	28	40	285	9684		63		18515	
NWHI	58651	0	1244	126544	1238	8611	23789	15819	0	2016	59	74061	11556
Other	258	18	13	100		7	34	232	26				

(onaga, opakapaka) around Christmas and New Year. The MHI landings show the largest apparent seasonal fluctuations, while seasonality in the NWHI landings is indistinct. Figure 12 (NMFS) shows number of trips per month in the NWHI; as mentioned earlier, fishing trips for bottomfish by part-time vessels peak in summer when tuna numbers are high and tuna prices low. Total landings for each species for 1987 for the MHI and NWHI are shown below (in the next section on Species Composition).

According to HDAR, the distribution of total bottomfish catches among areas changed slightly from 1986 to 1987. In the MHI, the Maui-Lanai-Kahoolawe-Molokai complex again dominated the MHI catches, with smaller contributions by Hawaii, Kauai-Niihau-Kaula, and Oahu, in descending order. In the NWHI, catches decreased in most of the areas, except for Gardner Pinnacles, Raita Bank, and Midway Islands. The Midway Islands is a newly reported area of activity from HDAR reports.

However, the NMFS report (Ralston and Kawamoto 1988) shows a somewhat different distribution of catch among areas. Evidence presented in Ralston and Kawamoto (1987) demonstrated that NWHI fishing activity shifted substantially to the northwest in 1986 compared with 1984-85. This was brought about by a major expansion of fishing effort at Lisianski Island. With the addition of information for 1987, we know that last year Maro Reef played a much larger role in bottomfish harvests than it had previously (Figure 13). Likewise, there was a small but definite harvest of fish from Salmon Bank and Ladd Seamount for the first time, while Pearl and Hermes Reef accounted for an increasing share of the catch. No catches were reported from Midway by NMFS data. **The overall effect is that fishing effort is apparently being distributed more uniformly throughout the NWHI, with less dominance by any one particular locality. The fishing up of virgin stocks of bottomfish seems to have largely run its course.**

The average distance traveled to the fishing grounds to catch a pound of opakapaka can be calculated from the data presented in Figure 13. The result indicates that average travel costs remained stable in 1987 relative to 1986; at this time, vessels are traveling an average of 770 nautical miles in order to catch opakapaka.

2. Species Composition

A great variety of fishes from throughout Oceania are marketed as bottomfish. The principal species are snappers (Lutjanidae), groupers (Serranidae), and jacks (Carangidae). Members of the snapper genus Pristipomoides are particularly numerous. (See NMFS data, Ralston and Kawamoto 1988 for a complete listing; the following is from that source.) The species composition of bottomfish taken in the Hawaiian fishery

Figure 11. Monthly catches for all species by zone: 1986-87. (HDAR, 1988).

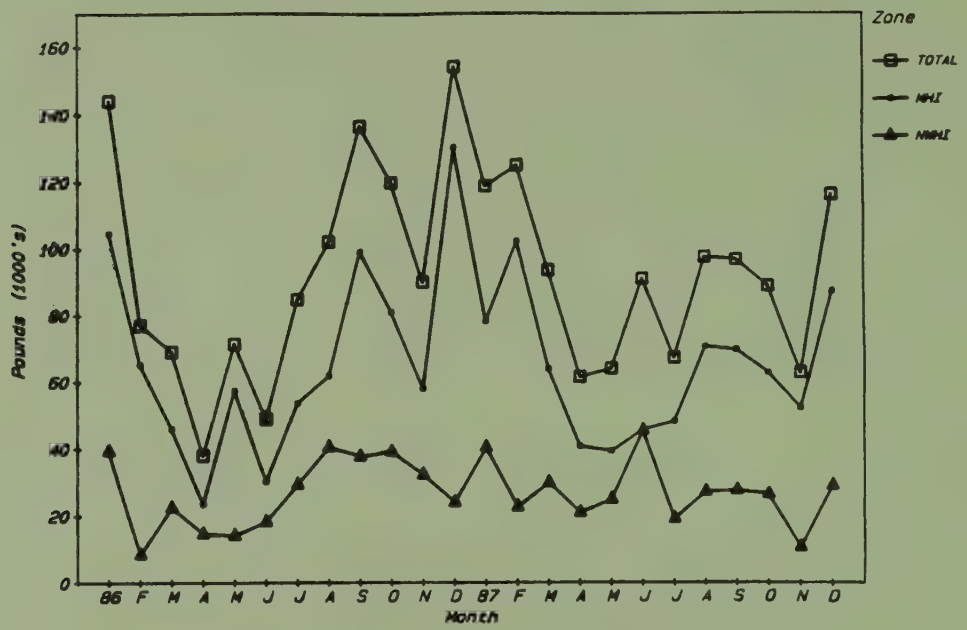


Figure 12. Seasonal composition of bottomfish fishing trips in the NWHI: 1986-87. (Pooley and Kawamoto, 1988).

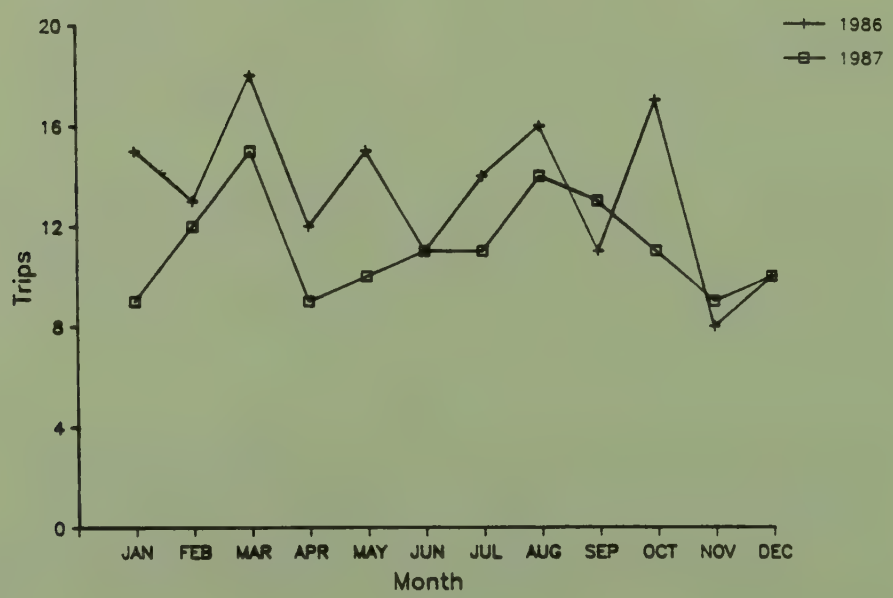


Figure 13. Locations of bottomfish and opakapaka harvests in the NWHI: 1984-87. MD = Middle Bank, NH = Nihoa, TW = Twin Banks, NK = Necker Island, FF = French Frigate Shoals, BR = Brooks Banks, RG = ST. Rogatien, GR = Gardner Pinacles, RT = Raita Bank, MR = Maro Reef, LY = Laysan Island, NT = Northhampton Seamount, PN = Pioneer Bank, LS = Lisianski Island, PH = Pearl and Hermes Reef, SB = Salmon Bank, and LD = Ladd Seamount. (Ralston and Kawamoto, 1988).

is more narrow (Table 11). There are 12 main species, including eight snappers, one grouper, two jacks, and the scorpionfish, Pontinus macrocephali. Note that opakapaka is the mainstay of the fishery, accounting for 36% of the sampled catch in 1987. The next most important species are onaga, hapuupuu, and butaguchi, each comprising about 15-16% by weight of the combined catch. Opakapaka and onaga (large snappers) continue to comprise the largest percentage of landings in the NWHI and MHI fisheries, while hapuupuu (sea bass) is another large proportion of the NWHI fishery and uluas (jacks) comprise a secondary proportion of both fisheries. Table 12 shows the NWHI percentage of total catch by species.

It should be noted that although opakapaka catch was high for 1987, some fishermen feel that this is because a concentration of fish at Maro Reef was found that had not been tapped before. There are most likely more pockets like this, but fishermen feel they do not necessarily reflect the overall status of this species. They feel that although the opakapaka catch was high for 1987, there is an overall trend of diminishing opakapaka stocks.

The (HDAR) species composition of the bottomfish catch for the MHI and NWHI zones can be seen in Figures 14A and 14B (and also in Table 9, shown earlier under CPUE). In the MHI, opakapaka has the highest landings, at 35.3% of total MHI landings of 757,585 pounds. Onaga is next highest, at 21.9%, followed by various "ulua" species (9.0%), uku (7.2%), taape (6.3%), ehu (5.9%), lehi (4.9%), kalekale (3.7%), kahala (2.6%), and hapuupuu (1.7%). Other species comprised 1.6% of the total. In the NWHI, opakapaka again has the highest landings at 39.2% of the total NWHI catch of 322,788 pounds. Butaguchi is second highest at 22.9%, followed by hapuupuu (18.2%), onaga (7.4%), ulua species (4.7%), white ulua (3.6%), ehu (2.7%), and gindai (0.6%). The other species comprised 0.8% of the NWHI total landings.

No landings of pelagic armorhead, Pseudopentaceros wheelri, were reported in HDAR catch reports. A moratorium on all commercial fishing for pelagic armorhead at Hancock Seamounts was instituted in 1986, with the adoption of the Fishery Management Plan for the Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region. (See section on HANCOCK SEAMOUNTS earlier in this report).

Table 13 shows both HDAR and NMFS species composition for the main species (by pounds) for 1986 and 1987.

Table 11. Landings of principal bottomfish species from the Main Hawaiian Islands (MHI) and Northwestern Hawaiian Islands (NWHI) sampled at the Honolulu wholesale market in 1984-87. (Ralston and Kawamoto, 1988).

Species	Region	Catch (metric tons)			
		1984	1985	1986	1987
Lehi	MHI	2.7	3.7	2.4	4.3
	NWHI	0.1	0.0	0.0	0.0
Uku	MHI	31.1	8.1	20.9	10.4
	NWHI	3.4	0.7	3.1	1.3
Ehu	MHI	6.5	12.9	11.9	12.6
	NWHI	2.2	9.3	12.5	15.0
Onaga	MHI	36.7	64.4	58.1	60.3
	NWHI	3.1	23.4	43.6	28.9
Taape	MHI	7.8	14.6	7.2	10.9
	NWHI	0.1	0.2	0.0	0.0
Opakapaka	MHI	37.5	30.9	36.5	57.6
	NWHI	143.4	140.5	122.6	137.8
Kalekale	MHI	4.4	6.9	5.6	7.6
	NWHI	1.3	2.9	2.8	1.6
Gindai	MHI	0.6	0.8	0.9	0.5
	NWHI	1.3	2.7	3.4	3.2
Hapuupuu	MHI	6.7	3.4	3.6	3.8
	NWHI	46.1	66.8	86.7	83.1
White Ulua	MHI	8.7	7.2	6.9	3.8
	NWHI	12.0	27.7	13.4	21.1
Butaguchi	MHI	0.8	0.4	0.6	1.2
	NWHI	29.5	56.2	66.1	80.8
Hogo	MHI	0.4	0.9	1.0	1.1
	NWHI	0.2	0.1	0.5	0.7
All 12 species:					
	MHI	144.0	154.2	155.7	174.3
	NWHI	242.7	330.4	354.7	373.5
Total		386.7	484.6	510.5	547.9

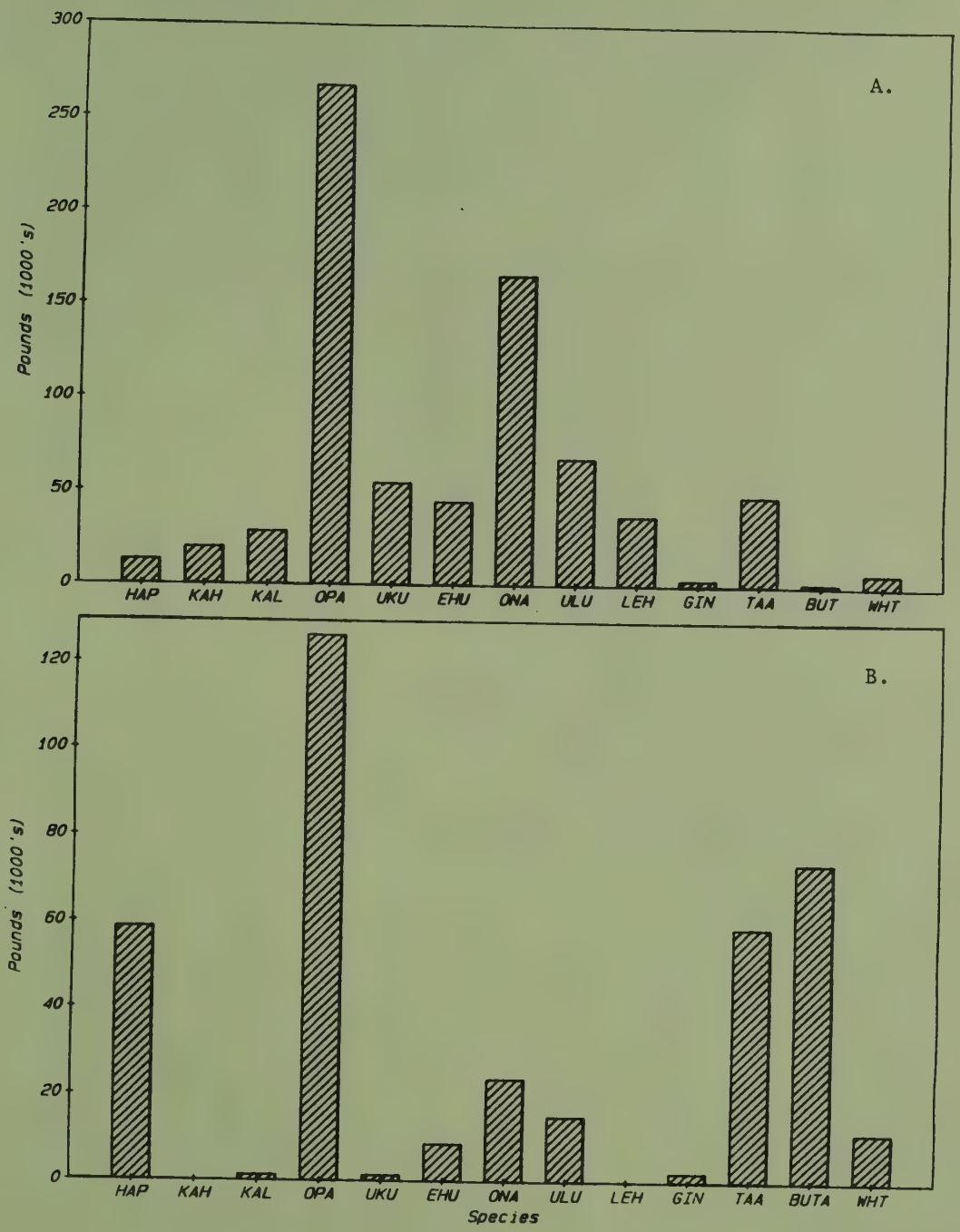
Table 12. NWHI bottomfish landings, percent of total catch by species: 1986-87. (Pooley and Kawamoto 1988).

Species	% of Total Pounds: 1986	1987
Opakapaka	35	37
Hapuupuu	24	22
Onaga	12	8
Butaguchi	19	22
Other	7	7
Ehu	4	4

Table 13. Species composition of Hawaii bottomfish catch: 1986-87. (NMFS data are pounds sold, HDAR data are pounds landed. NMFS numbers are from Pooley and Kawamoto 1988.)

	1986		1987	
Species	HDAR	NMFS	HDAR	NMFS
Opakapaka	288,463	485,300	380,583	630,800
Onaga	235,284	371,500	187,276	350,800
Ehu	57,119	85,800	51,358	97,400
Hapuupuu	102,639	245,600	68,915	240,400
Butaguchi (Ulua)	71,901	177,600	75,522	222,400
Other	323,081	256,500	278,297	245,000

Figure 14A/B. Total catch of bottomfish management species during 1987 in the Main Hawaiian Islands (A) and the Northwestern Hawaiian Islands (B). (HDAR, 1988).



F. Biological Assessment of the Landings

The information presented below is from a report prepared by NMFS HL (Ralston and Kawamoto 1988). The report is a detailed biological assessment of the Hawaiian bottomfish stocks, both in the MHI and NWHI, based on data collected at the Honolulu fish auction from 1984 to 1987.

1. Maximum Sustainable Yield (MSY)

Ralston and Kawamoto (1987) estimated the maximum sustainable yield for the Hawaiian Islands multi-species bottomfish fisheries. They estimated MSY for the MHI at 285 metric tons (627,000 pounds) and MSY for the NWHI at 275 metric tons (605,000 pounds). The 1987 HDAR MHI catch exceeds the MHI MSY by 20.8% while the total NWHI catch is 53.4% of the NWHI MSY. In comparison, the NMFS estimate of the total 1987 MHI catch exceeds the MSY by 36% and the total NWHI estimated catch exceeds its MSY by 68%.

After an analysis of size-frequency data by species (see below) and other critical fishery statistics (see Ralston and Kawamoto 1988), they conclude that in general there is little evidence that NWHI stocks of bottomfish are stressed. **Although the estimates of NWHI catch exceed the estimated MSY, the multi-species fishery is probably in a state of non-equilibrium and MSY estimates are somewhat ambiguous. It does not appear that immediate action to further manage NWHI stocks is necessary.**

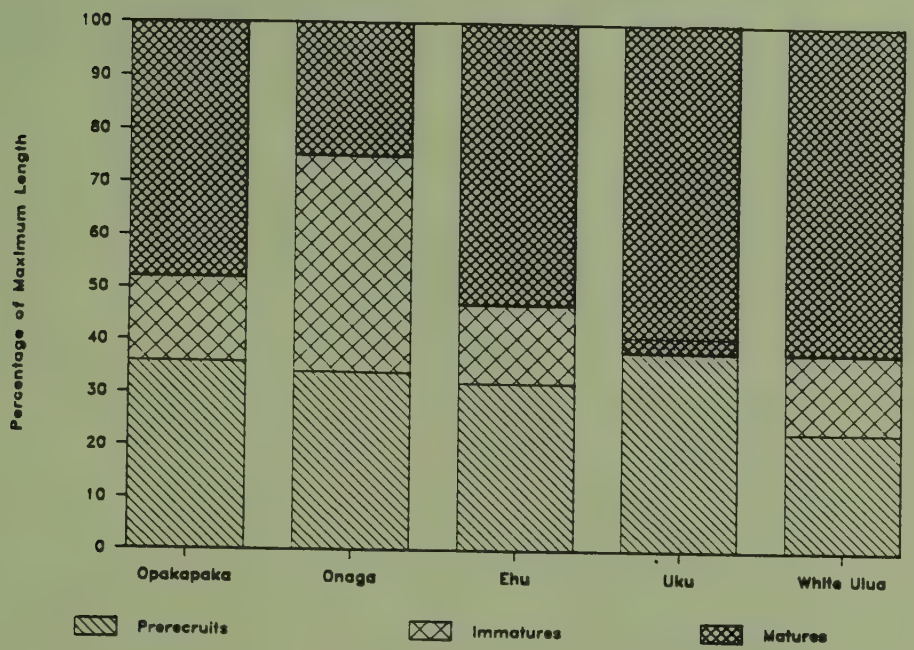
However, the situation in the MHI is more problematic. There is evidence that total catch exceeds the best estimate of MSY and that a persistent pattern of harvesting undersized (immature) fish exists, especially for opakapaka, onaga, ehu, and white ulua (Figure 15). **The BPMT recommends that limitations on the commercial sale of undersized fish and the establishment of recreational "bag limits" be seriously considered.**

2. Size-Frequency Data by Species

Ralston and Kawamoto (1988) performed a detailed size-structured analysis of 11 bottomfish species. A brief summary of their conclusions for each species follows.

A list of the islands and banks in the Hawaiian archipelago is provided following Figures 15 through 22 to help the reader identify the zone codes used in these figures.

Figure 15. Relationship of length at entry to the fishery and length at maturity to maximum length for five bottomfish species from the Main Hawaiian Islands. In each case, the lower "prerecruit" portion represents the lifespan up until length at entry to fishery. The middle "immature" portion indicates the range during which fish are harvested but have not had the opportunity to reproduce. The top "mature" portion displays that part of the lifespan during which breeding takes place. (Ralston and Kawamoto, 1988).



Zone	Islands and Banks Included
1	Hawaii, Maui, Kahoolawe, and Lanai
2	Molokai, Oahu
3	Kauai, Niihau
4	Middle Bank, Nihoa, Twin Banks, and Necker Island
5	French Frigate Shoals, Brooks Banks, St. Rogatien, and Gardner Pinnacles
6	Raita Bank, Maro Reef, Laysan Island, and Northampton Seamount
7	Pioneer Bank, Lisianski Island
8	Pearl and Hermes Reef, Salmon Bank, and Ladd Seamount

Opakapaka

The yield-per-recruit analysis indicates that the MHI opakapaka fishery is marginally growth-overfished. Growth-overfishing occurs when fish are harvested at a size smaller than the optimum level which would produce the highest yield (by weight) from the resource. The opakapaka stocks from Hawaii to Oahu are exposed to substantially higher fishing mortality than those around Kauai and Niihau. The fish are entering the MHI fishery at a size substantially less than the size when they reach sexual maturity. In the NWHI, the opakapaka enter the fishery much larger and there is no indication that growth-overfishing is occurring (Figure 16 A,B).

Onaga

The situation of onaga in the MHI is similar to opakapaka, except that estimated fishing mortality is much lower. Onaga are also entering the MHI fishery at an immature size. In the NWHI, the onaga enter the fishery at a substantially larger size and the stocks are in no danger of overfishing. (Figure 17 A,B).

Ehu

Based on the NMFS analysis, ehu are the most severely stressed stock in the MHI. A large number of fish are being caught at less than 0.5 pound. The size at entry is very immature, and the stock is exposed to high fishing mortality. Ralston and Kawamoto conclude that the MHI ehu are substantially growth-overfished. The severity of the growth-overfishing is such that concern over possible recruitment-overfishing is warranted. (Figure 18 A,B).

The NWHI stocks are in substantially better condition and the size at entry is about the age of first

Figure 16A. Weight-frequency distribution of MHI and NWHI opakapaka based on 1987 market samples. (Ralston and Kawamoto, 1988).

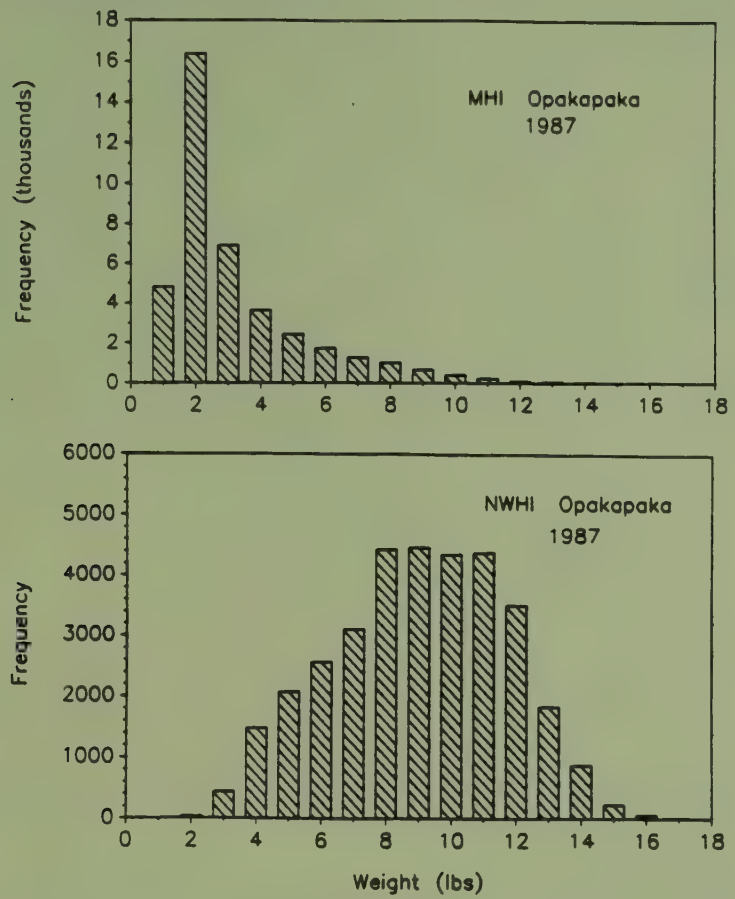


Figure 16B. Estimates of opakapaka weight at entry for different Hawaiian geographical zones. (Ralston and Kawamoto, 1988).

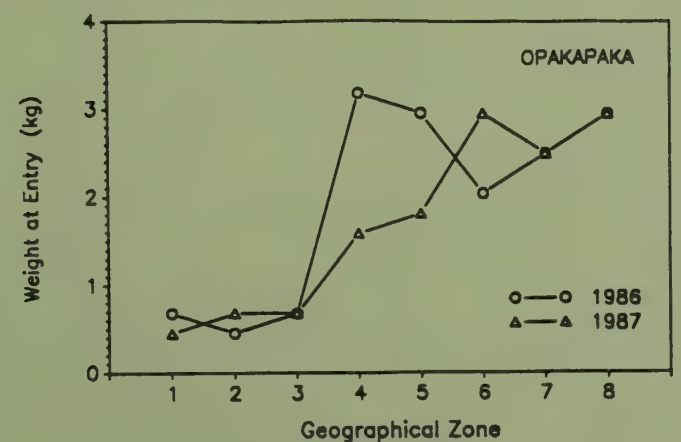


Figure 17A. Weight-frequency distribution of MHI and NWHI onaga based on 1987 market samples. (Ralston and Kawamoto, 1988).

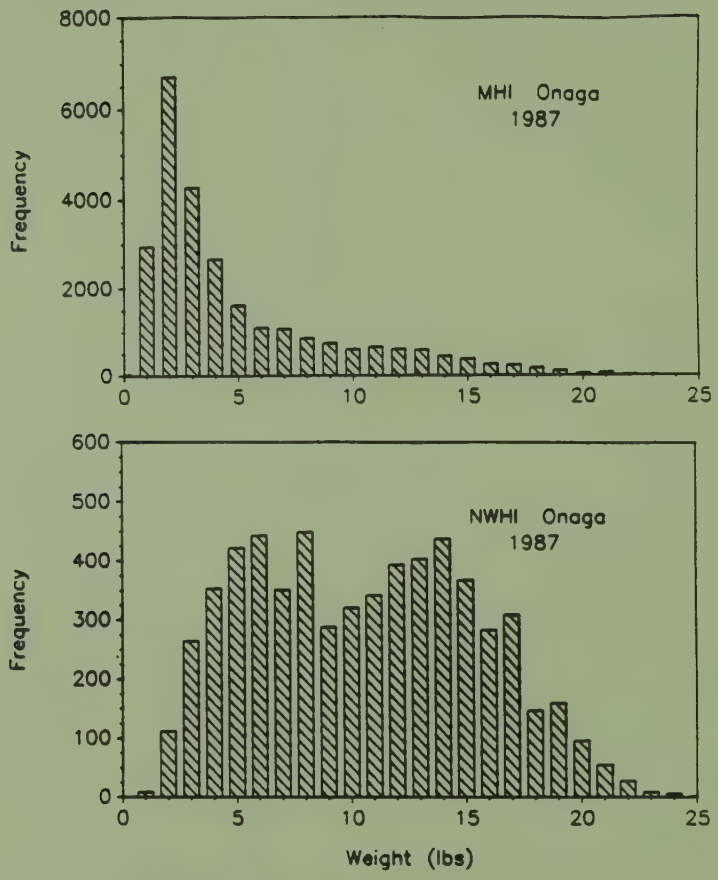


Figure 17B. Estimates of onaga weight at entry for different Hawaiian geographical zones. (Ralston and Kawamoto, 1988).

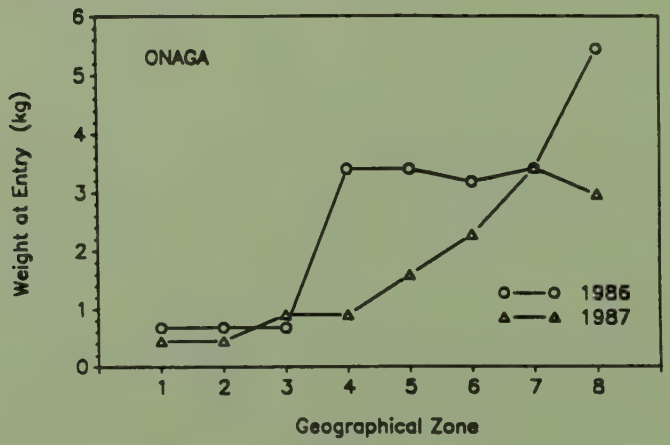


Figure 18A. Weight-frequency distribution of MHI and NWHI ehu based on 1987 market samples. (Ralston and Kawamoto, 1988).

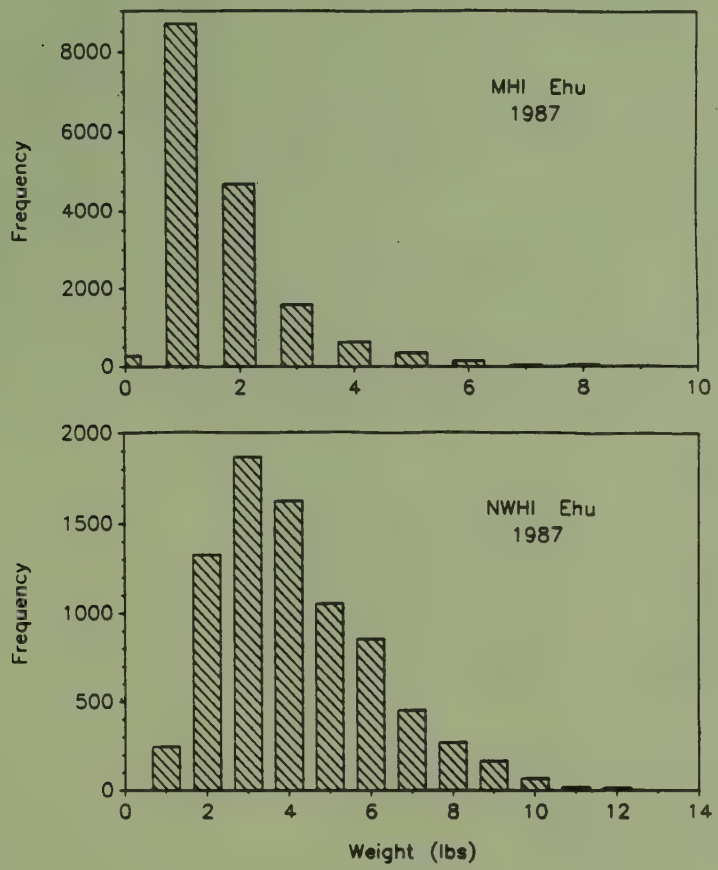
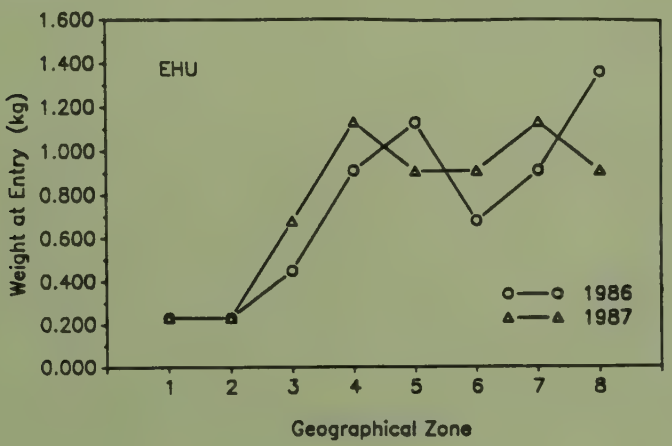


Figure 18B. Estimates of ehu weight at entry for different Hawaiian geographical zones. (Ralston and Kawamoto, 1988).



reproduction. Although the status of NWHI ehu is satisfactory, the ehu show the effects of fishing more than the previous two species. (Figure 18 A,B).

Uku

The MHI uku stocks show evidence of growth-overfishing, but fishing mortality decreased in 1987 from previous years. There are not enough data on NWHI stocks of uku for a complete analysis. (Figure 19 A,B).

Hapuupuu

The MHI fishery is close to being optimally fished from a yield-per-recruit perspective. The NWHI stocks, however, show the reverse trend from other species analyzed so far. The size at entry for the NWHI fish is lower than for the MHI. However, the analyses indicate that the fishing mortality rate in the NWHI could be increased. (Figure 20 A,B).

Butaguchi

No yield-per-recruit analyses could be performed on this species. The MHI fishery for this species is insignificant but the NWHI fishery is substantial. Ralston and Kawamoto concluded that there is no evidence for overfishing of butaguchi in the NWHI. (Figure 21 A,B).

White Ulua

The size at entry into the fishery for the MHI stocks is substantially smaller than for the NWHI stocks. A very large harvest of juvenile white ulua (papio) is taking place in the MHI and is the cause for concern of recruitment-overfishing in the MHI. The dramatic steepness of the descending length-frequency curve for MHI white ulua shows the paucity of medium to large fish in the MHI fishery. However, more data need to be collected and analyzed before firm recommendations for this species can be made. (Figure 22 A,B,C).

Other Species

Analyses of the kalekale (Figure 23), gindai (Figure 24), hogo (Figure 25), and lehi (Figure 26) stocks show no major changes in the size-structure from 1984 to 1987. Weight at entry and mean size of fish caught in the MHI, as seen in most bottomfish species, is less than those fish caught in the NWHI. The stocks of these species do not yet show indications of overfishing. Note that lehi is not caught in the NWHI, therefore no weight-frequency polygons are present for any years for the NWHI (Figure 26).

Figure 19A. Weight-frequency distribution of MHI uku based on 1987 market samples. (Ralston and Kawamoto, 1988).

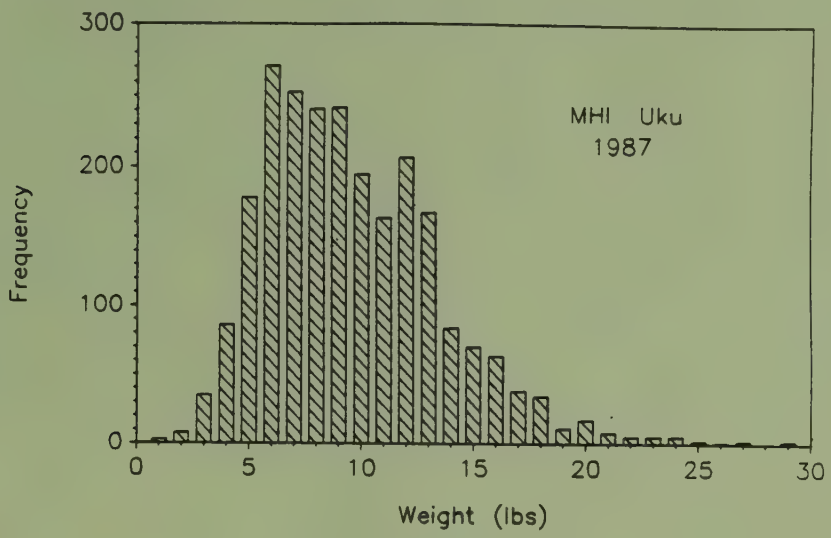


Figure 19B. Estimates of uku weight at entry for different Hawaiian geographical zones. (Ralston and Kawamoto, 1988).

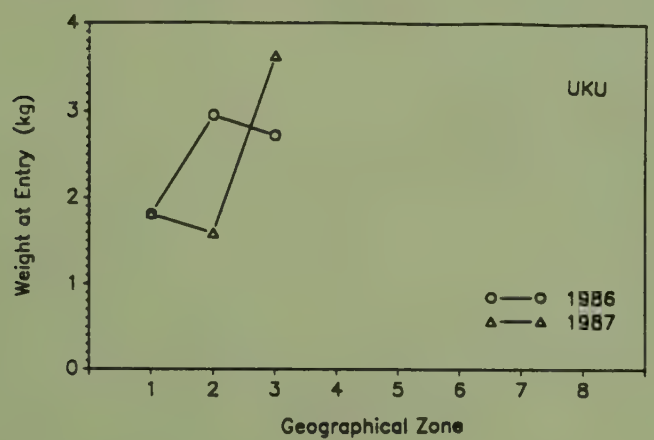


Figure 20A. Weight-frequency distribution of MHI and NWHI hapuupuu based on 1987 market samples. (Ralston and Kawamoto, 1988).

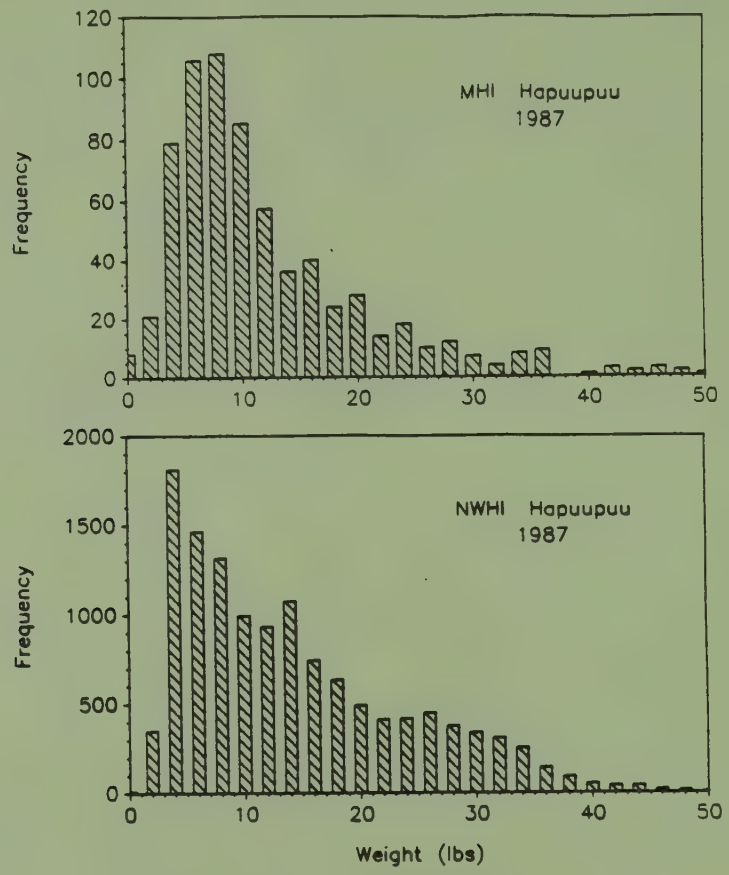


Figure 20B. Estimates of hapuupuu weight at entry for different Hawaiian geographical zones. (Ralston and Kawamoto, 1988).

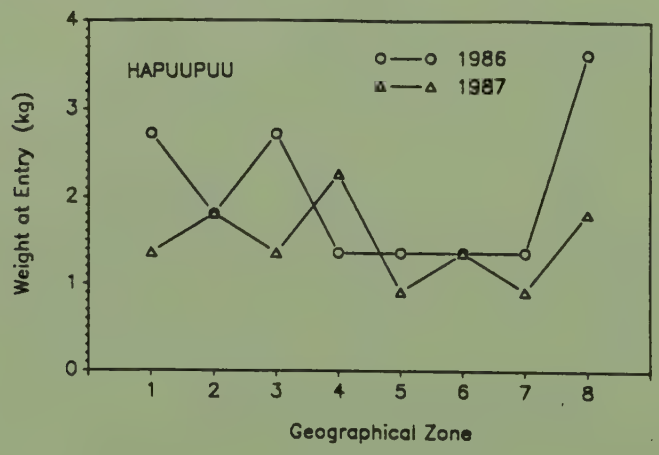


Figure 21A. Weight-frequency distribution of NWHI butaguchi based on 1987 market samples. (Ralston and Kawamoto, 1988).

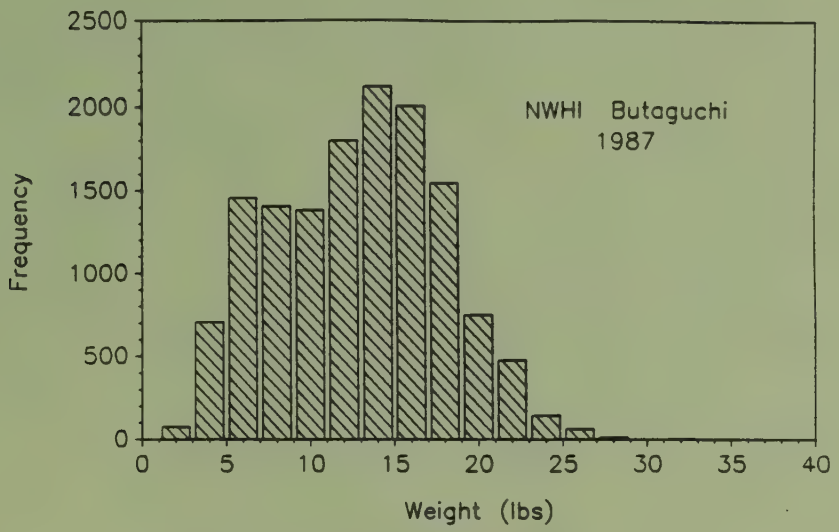


Figure 21B. Estimates of butaguchi weight at entry for different Hawaiian geographical zones. (Ralston and Kawamoto, 1988).

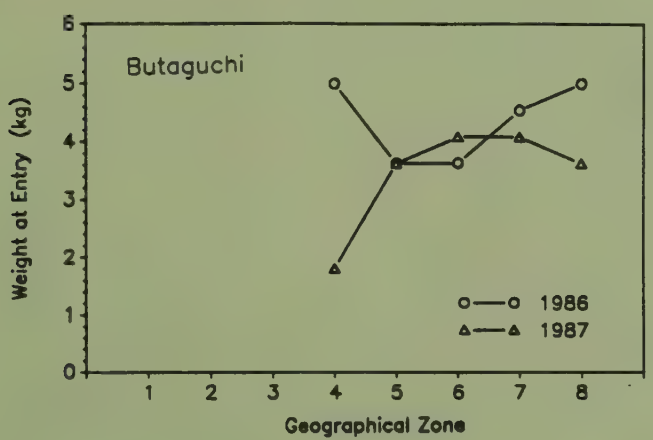


Figure 22A. Weight-frequency distribution of MHI and NWHI ulua based on 1987 market samples. (Ralston and Kawamoto, 1988).

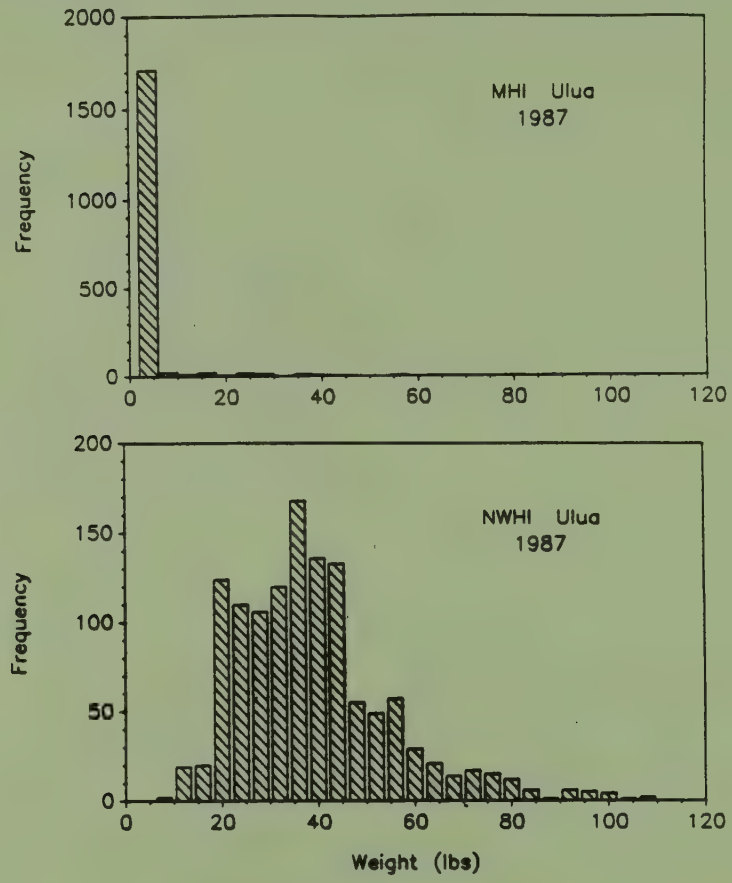


Figure 22B. Estimates of white ulua weight at entry for different Hawaiian geographical zones. (Ralston and Kawamoto, 1988).

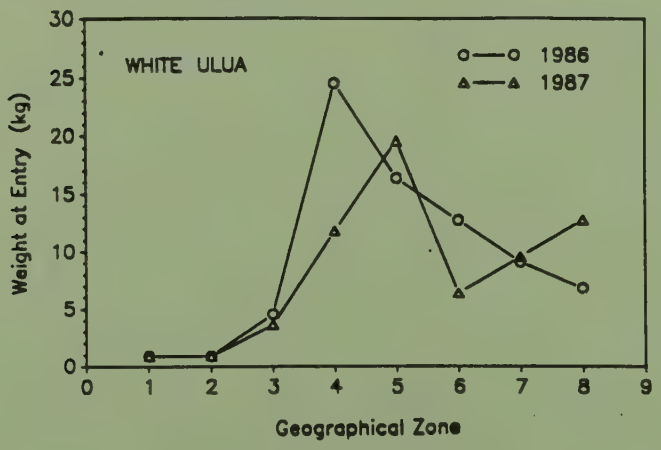


Figure 22C. Weight-frequency distributions of MHI and NWHI white ulua based upon market samples obtained from 1984-86. (Ralston and Kawamoto, 1988).

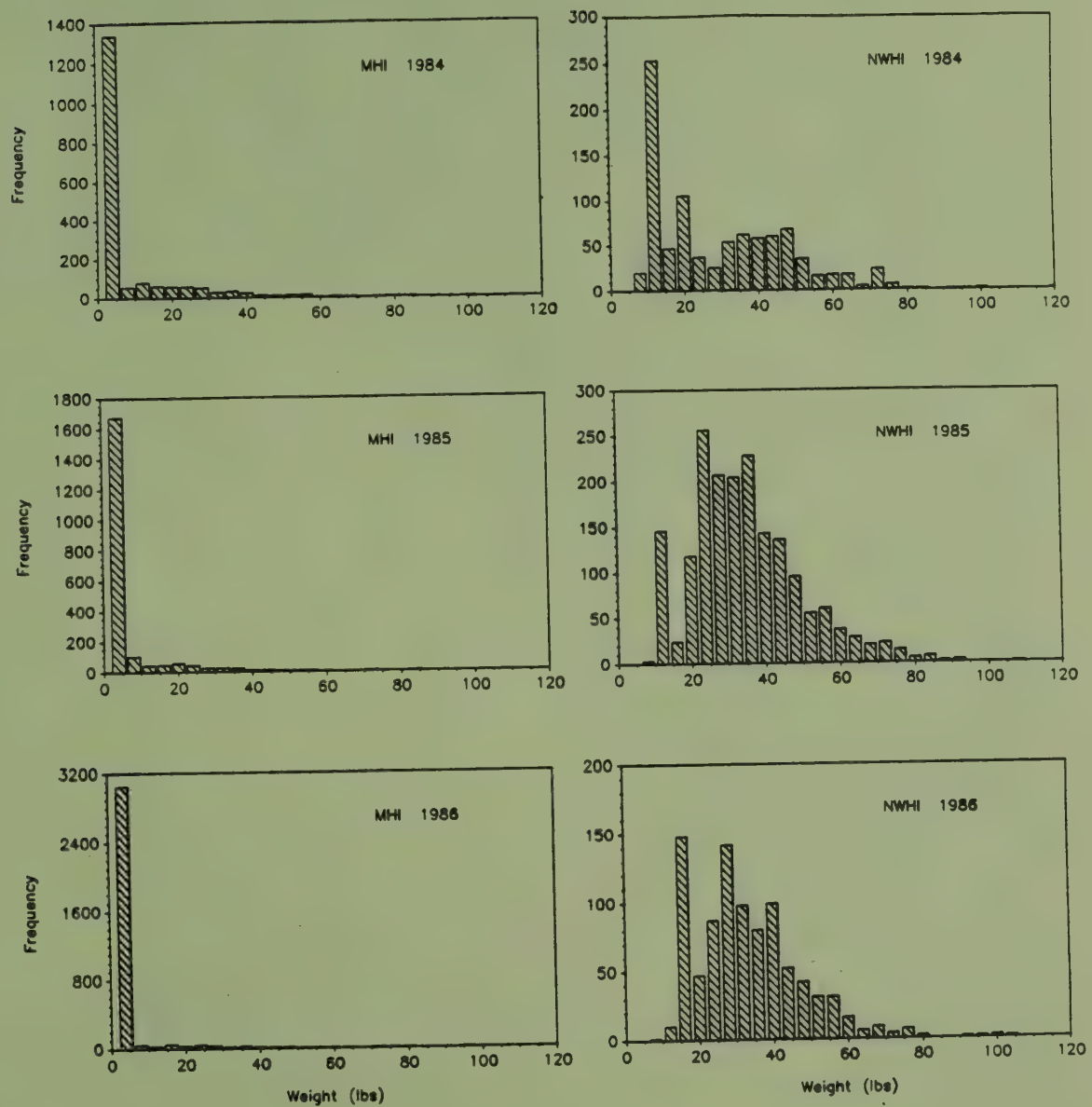
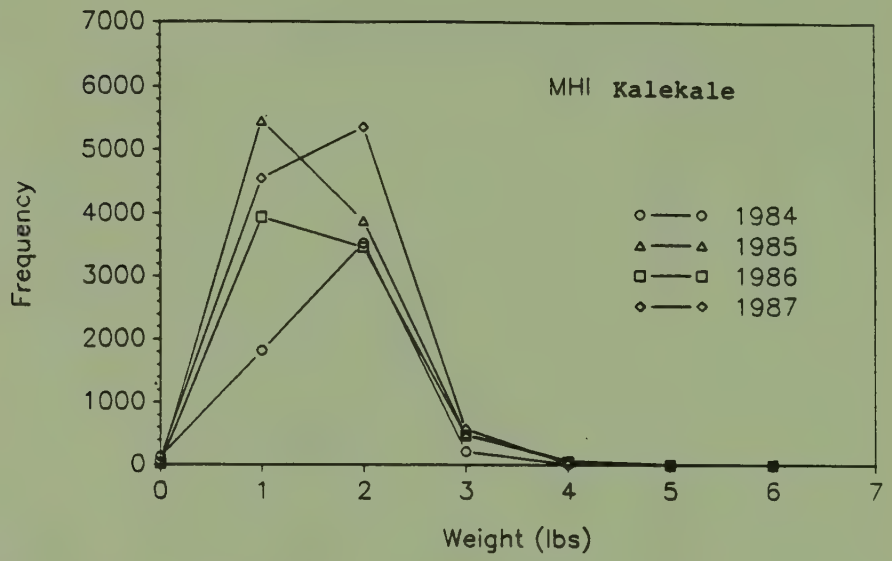


Figure 23. Weight-frequency polygons for MHI and NWHI kalekale: 1984-87. (Ralston and Kawamoto, 1988).



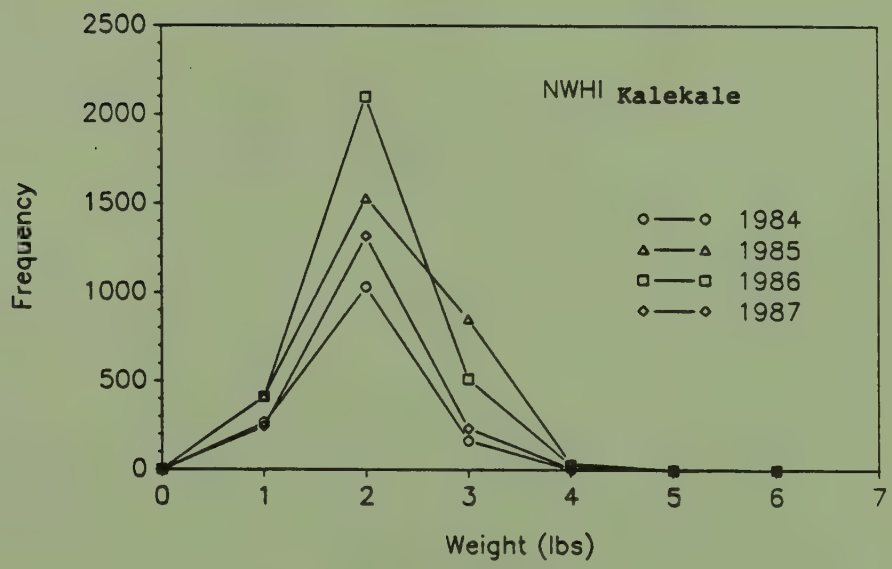


Figure 24. Weight-frequency polygons for MHI and NWHI gindai: 1984-87. (Ralston and Kawamoto, 1988).

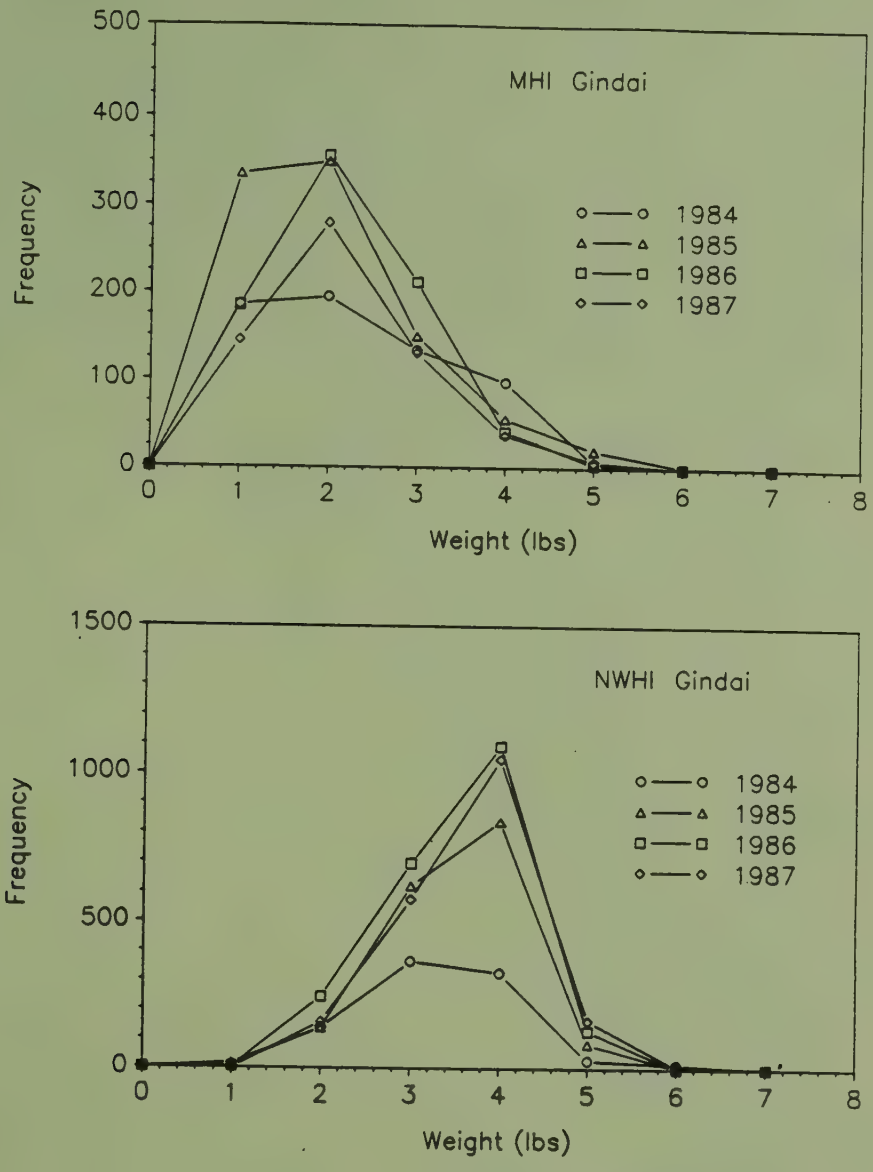


Figure 25. Weight-frequency polygons for MHI and NWHI hogo: 1984-87. (Ralston and Kawamoto, 1988).

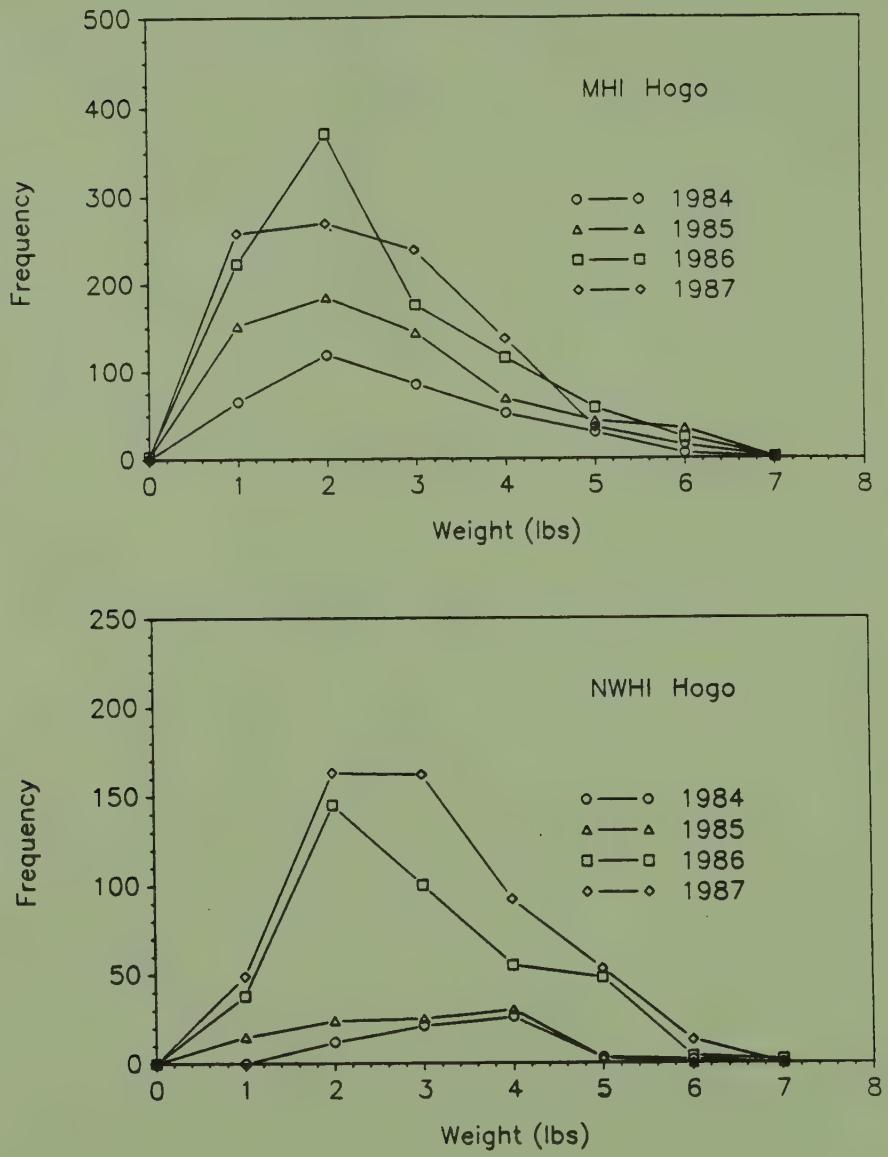
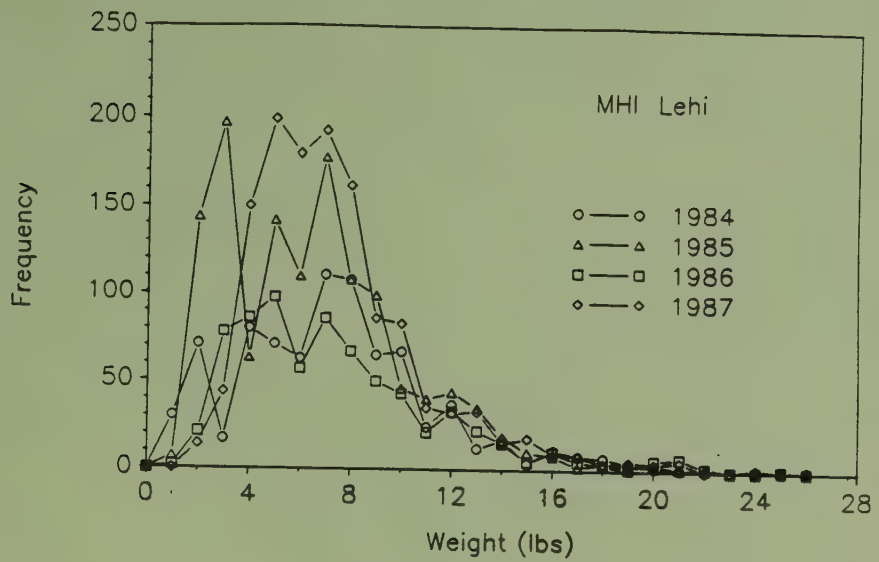


Figure 26. Weight-frequency polygons for MHI lehi: 1984-87. (Ralston and Kawamoto, 1988).



G. Summary Table of Fishery Status

Status of the Main Hawaiian Islands Bottomfish Fishery

Problem Condition	Present in the Bottomfish Fishery	Comment
1. Age at entry is prereproduction	Yes (opakapaka, onaga, ehu, white ulua) No (Other spp.)	See Ralston and Kawamoto (1988)
2. Unacceptable ratio of fish mortality to natural mortality	Yes (For some spp.)	Borderline for opakapaka, high for ehu and uku
3. Catch exceeds maximum sustainable yield	Possibly	Ralston and Kawamoto (1988)
4. Significant decline in CPUE	Uncertain	
5. Substantial decline in ex-vessel revenue relative to baseline levels	Uncertain	
6. Significant shift in gear, by area	No	
7. Significant change in the frozen/fresh components of catch	No	
8. Unstable pattern of entry/exit to the fishery	Yes	Pooley and Kawamoto (1988)
9. Per trip costs exceed per trip revenues	Uncertain	Pooley and Kawamoto (1988)

Status of the MHI Bottomfish Fishery (...cont.)

Problem Condition	Present in the Bottomfish Fishery	Comment
10. Significant decline or increase in total bottom-fish landings	No	
11. Change in species composition of catch	Uncertain	Pooley and Kawamoto (1988)
12. Research results indicate problems	Yes	See Ralston and Kawamoto (1988)
13. Habitat degradation or environ-mental problems	No	
14. Increased interaction with protected species	No	

Status of the Northwestern Hawaiian Islands Bottomfish Fishery

Problem Condition	Present in the Bottomfish Fishery	Comment
1. Age at entry is prereproduction	No	
2. Unacceptable ratio of fish mortality to natural mortality	No	Data on specific areas is limited
3. Catch exceeds maximum sustainable yield	Yes	See Ralston and Kawamoto (1988), but fishery is in dis-equilibrium
4. Significant decline in CPUE	No	
5. Substantial decline in ex-vessel revenue relative to baseline levels	Yes	See report by Meyer, 1987, WESTPAC Publ.
6. Significant shift in gear, by area	No	
7. Significant change in the frozen/fresh components of catch	No	
8. Unstable pattern of entry/exit to the fishery	Yes	New entry continues each year and there is an accelerated "churning" effect in the fleet (See Meyer,1987)
9. Per trip costs exceed per trip revenues	Yes	Fixed plus variable costs exceed revenues (Pooley and Kawamoto, 1988)

Status of the NWHI Bottomfish Fishery (...cont.)

Problem Condition	Present in the Bottomfish Fishery	Comment
10. Significant decline or increase in total bottomfish landings	Yes	Significant fluctuations in landings between 1977 and 1987.
11. Change in species composition of catch	Yes	Ralston and Kawamoto (1988)
12. Research results indicate problems	No	
13. Habitat degradation or environmental problems	No	
14. Increased interaction with protected species	No	

II. RECENT RESEARCH

The Council and NMFS are jointly involved in various studies on Hawaii's fish market and bottomfish fishing fleet. Research is proposed or ongoing regarding three topics: market monitoring, voluntary catch logbook program, and estimating vessel operating costs in the NWHI fishery.

The Council and NMFS are exploring the means for expanding the NMFS market sample size to include a wider number of wholesale outlets. NMFS has proposed a new Hawaii-wide survey of all seafood markets to provide a new baseline for scaling market samples while the Council is presently supporting a neighbor island wholesale market monitoring program in collaboration with the HL.

Council staff, NMFS scientists, and local commercial fishermen designed a daily catch logbook for the NWHI bottomfish fishermen. By July 1988, six of the estimated eight full-time active NWHI bottomfish vessel owners and/or captains had agreed to participate in this voluntary logbook program. The program is intended to acquire more accurate information on fishing effort by fishing area thereby allowing better knowledge of the conditions of area specific stocks of various bottomfish species.

Beginning in late 1987, NMFS began collecting information on the cost of fishing for NWHI bottomfish. They anticipate completing this data collection by mid-1988 and reporting the results in early 1989. In a cooperative project with the Council, they are initiating an operational analysis of the NWHI bottomfish fleet.

In 1987, NMFS conducted research on Hawaii's bottomfish fishery which resulted in the following Administrative Reports (see the Reference Section for the complete citation). These publications constitute the modules for the 1987 annual report and their results are presented in this document.

1) ASSESSMENT OF THE STOCK CONDITION OF PELAGIC ARMORHEAD ON SOUTHEAST HANCOCK SEAMOUNT. D.A Somerton, 1988.

2) A BIOLOGICAL ASSESSMENT OF HAWAIIAN BOTTOMFISH STOCKS, 1984-87. Ralston and Kawamoto, 1988.

3) STATUS OF HAWAII'S BOTTOMFISH FISHERY IN 1987. Pooley and Kawamoto, 1988.

Other research related to Hawaii's bottomfish fishery includes work in the Main Hawaiian Islands conducted on Penguin Banks off the island of Molokai. The University of Hawaii Sea Grant College is sponsoring ongoing efforts to study low trophic

level productivity and evaluate the impact of benthic water currents on nutrient mixing. In addition the Hawaii Cooperative Fishery Research Unit is studying diet differences of various bottomfish species found on the Penguin Banks.

III. HABITAT CONDITIONS AND RECENT ALTERATIONS

HDAR DEEPWATER ARTIFICIAL REEF. Approximately 5,000 tons of material were deployed in HDAR's Ewa Deepwater Artificial Reef. A 133 foot derelict barge and two surplus caissons were donated and deployed by the U.S. Navy during July-August 1987. In addition, the HDAR installed 1,000 tons of concrete pipes, slabs, and boulders at the Oahu deepwater reef site in January, 1988.

Handline sampling at the deepwater reef site after the establishment of the reef resulted in a catch of 88 fish in 11 hours of fishing on seven trips from August, 1987 to May, 1988. Opakapaka and taape composed 24% and 51%, respectively, of the catch. Previous to the installation of the artificial reef, no fish were caught in 2.25 hours of fishing at the reef site.

NMFS. Under the Fishery Management Plan (FMP), regulations were implemented to prohibit the use of bottom trawls, bottom-set nets, explosives and poisons for harvesting bottomfish. This has served to greatly reduce the potential for bottomfish habitat degradation. To our knowledge, there have been no violations of these regulations in 1987.

As reported in the 1986 annual report, there are several activities occurring or reportedly occurring in the FCZ which potentially may alter bottomfish habitat. These include:

1. Anchor damage by vessels attempting to maintain position over productive bottomfish habitat.

2. Habitat damage from heavy weights and line entanglement during normal hook-and-line bottomfish operations.

3. Habitat damage by illegal foreign fishing activities for precious corals using coral dredges.

An activity which potentially may impact bottomfish habitat is a proposal to lease 26,910 square kilometers of the EEZ surrounding the Hawaiian Archipelago and Johnston Island for mining of cobalt rich manganese crusts. A joint State-Federal Task Force, which includes a staff member from the NMFS Habitat Conservation Program, has been created to develop an environmental impact statement (EIS) for the proposed activity. The Draft EIS, "Proposed Marine Mineral Lease Sale in the Hawaiian Ar-

chipelago and Johnston Island Exclusive Economic Zones", was published in January 1987. The draft EIS is presently under review.

The potential threat to bottomfish habitat can now be reviewed through the Council's newly established Ecosystems and Habitat Committee. The Committee has recommended the adoption of a Habitat Policy by the Council which will assure that each fishery management plan includes all available information on habitat significant to the species to be managed.

The NMFS initiated a bottomfish habitat enhancement program in October 1985 when a series of deepwater artificial reefs were placed on the bottom at Penguin Bank. Initial surveys indicate a substantial increase in biomass of bottomfish at these sites. Monitoring of the artificial reefs will continue for at least another three years.

IV. ENFORCEMENT ACTIVITIES AND PROBLEMS

There were no reported violations of bottomfish regulations in 1987 requiring action by NMFS enforcement officers. Enforcement monitoring activities are limited to ensuring vessel compliance with the NWHI permit requirement and prohibitions on the use and possession of destructive fishing gear.

There were no reported incidental takes or fishery interactions with protected species by permitted vessels in 1987.

V. NMFS ADMINISTRATIVE ACTIONS

Regulations implementing the FMP for the Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region went into effect on August 27, 1986. Among the provisions of the FMP is a requirement that all vessels fishing for bottomfish or seamount groundfish in the NWHI have a permit issued by NMFS.

For the calendar year 1987, a total of 48 vessels were issued permits for the NWHI bottomfish fishery. Permits issued under the FMP are valid for a one year period from July 1 - June 30. This schedule was selected by the Council in order to coincide with the permit year used by the State of Hawaii. The State of Hawaii is considering a change in its commercial fishing permit year which would make permits valid for a period of one year after the date of issuance. The Council recently modified the bottomfish permit schedule to operate on a calendar year (January-December) basis. This permit adjustment accompanied the Council's proposed Amendment #2 to the FMP for a limited entry program in the NWHI bottomfish fishery.

The Council's decision to pursue limited entry as a management approach for this fishery resulted from concerns expressed by fishermen as early as 1984, that NWHI bottomfish stock were being exploited by too many vessels. It was believed that the average operation was loosing money due to an increasing number of boats fishing a declining resource. Therefore, the Council began the process of developing a limited entry program designed to stabilize the fishery's economic health while protecting NWHI bottomfish stocks from overfishing in the future.

In planning for limited access management in the NWHI, the Council designated August 7, 1985, as the control date for establishing historic participation in the fishery. Throughout 1987, the Council worked on preparing an amendment to the Bottomfish FMP which would establish a limited access management program for the NWHI bottomfish fishery. In April 1988, the Council completed Amendment #2 to the FMP establishing a limited access program for the NWHI and submitted the amendment to NMFS for review. A Notice of Availability was published in the Federal Register on April 18th and proposed regulations were published on May 11th (53FR16735). The public comment period on the amendment and proposed rule ended on June 20th. On July 15, 1988, Amendment #2 to the Bottomfish and Seamount Groundfish FMP was approved by the Secretary of Commerce. The limited entry program for the NWHI bottomfish fishery will go into effect on January 1, 1989.

The limited entry program establishes access limitation criteria for persons (and their boat) wishing to pursue bottomfish fishing in the NWHI west of the 165 degree west longitude line (just west of Necker Island). This area is called the Ho'omalu Zone. Access will remain unrestricted to vessels operating around the Main Hawaiian Islands or that part of the NWHI named in the plan as the "Mau Zone", an area located from 161 degrees west longitude (just west of Nihoa Island) out to 165 degrees west. The eligibility criteria for Ho'omalu Zone fishermen, is based on their historical fishing record. An individual is eligible for a Ho'omalu Zone permit if he/she can provide adequate documentation (State catch report) indicating they caught bottomfish in the NWHI prior to August 7, 1985. All such persons are considered "grandfathered" into the fishery. Further details regarding fishermen's eligibility criteria and the permit application process under the plan are available from NMFS Western Pacific Program Office located in Honolulu, Hawaii, or at the Council's downtown Honolulu office.

VI. STATE/TERRITORY MANAGEMENT ACTIONS

As mentioned above, the State of Hawaii is considering a change in its commercial fishing permit year which would make permits valid for a period of one year after the date of is-

suance. The validity period for State commercial bottomfish permits could, like the Federal permit system, be revised to coincide with the calendar year.

VII. COUNCIL ACTIONS

A. Assessment of Need for Council Action

In October 1987, Amendment #1 to the Bottomfish FMP was approved and implemented. Amendment #1 changed the due date for the annual bottomfish report from March 31st to June 30th and authorized the Council to consider and propose limited access measures for bottomfish fisheries in the EEZ surrounding American Samoa and Guam. The original FMP had reserved limited access management proposals for the NWHI only. In a previous action, the Council had established May 30, 1986, as the control date for establishing historic participation in the bottomfish fisheries of American Samoa and Guam.

B. Recommendations for Council Action

A complete list of BPMT recommendations for the Western Pacific Region was presented earlier in the front of this report. The Council has recommended the following for the Hawaiian Islands:

Consideration of size limits in the Hawaiian Islands bottomfish fishery. The BPMT reviewed the analyses presented in "A Biological Assessment of Hawaiian Bottomfish Stocks, 1984-87" by Ralston and Kawamoto (SWFC Administrative Report H-88-8) and was troubled by the pervasive harvest of undersized, juvenile bottomfish in the Main Hawaiian Islands. The small size at entry to the fishery of opakapaka, onaga, ehu, and white ulua was particularly disturbing. Based on this clear warning sign of overfishing, the BPMT recommends that the Council investigate the desirability, and pursue implementation, of meaningful size limits on the commercial sale of bottomfish that are caught in Hawaiian waters. Due to transboundary jurisdiction over the bottomfish resource, especially in the Main Hawaiian Islands, such action must be carried out in close cooperation with the State of Hawaii.

Resolution of disparities in Hawaii bottomfish data bases. There is significant divergence between the HDAR catch statistics for NWHI bottomfish and the NMFS Honolulu monitoring program of landings at wholesale markets. It is evident that NWHI bottomfish catches are significantly under-reported to the State. It is recommended that the Council establish a task force (composed of NMFS, HDAR, Council personnel and NWHI bottomfish fishermen) whose task would be to help resolve the data disparity problem, and to recommend the best means of data collection which

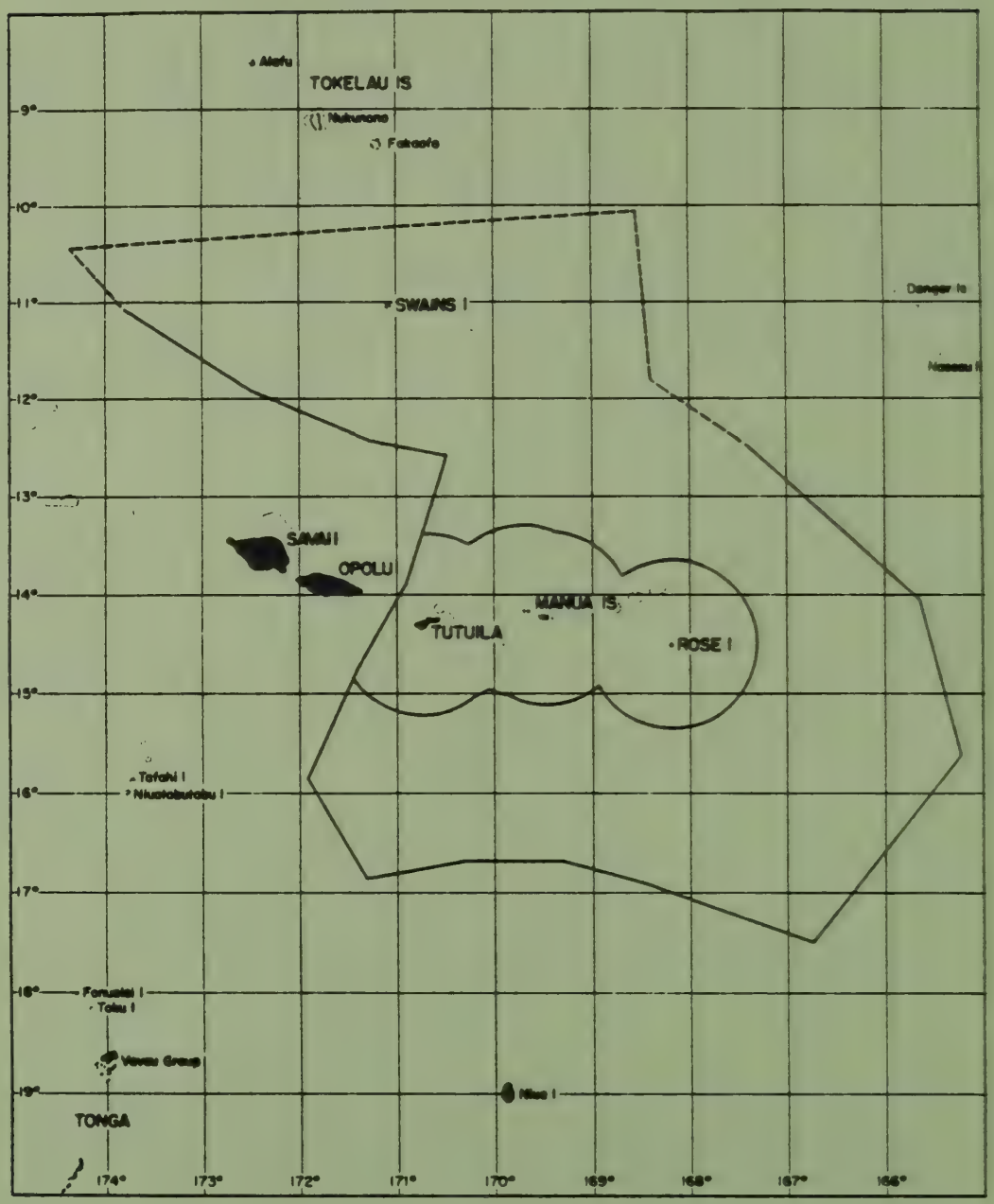
would be sufficient for stock assessment and other plan monitoring purposes.

C. Estimated Impacts of Recommended Action

Heavily exploited bottomfish stock located around the Main Hawaiian Islands would likely benefit from the establishment of minimum size limits for bottomfish caught for commercial sale. A minimum size limit would increase protection against overfishing for population of those specific bottomfish species targeted by the management measure. It is feasible that recreational fishermen (those who do not sell their catch) would not be subject to the regulation and could potentially benefit from its implementation. Fishing pressure on small juvenile bottomfish would be reduced from the commercial fishing sector with the possible effect of increased fishing success of recreational bottomfish fishermen. Provided the increased success of recreational fishermen does not completely compensate for the reduced landings of small bottomfish by commercial fishermen, the overall benefit to Main Hawaiian Islands bottomfish stocks would be positive due to a net reduction in effective fishing effort.

Resolving existing differences between various data sources for fish landed in the Hawaiian archipelago is much needed. It is a fundamental step toward; 1) understanding the quality of available catch statistics; 2) identifying the best use of the available information; and 3) identifying what remaining data needs must be gathered to best manage and conserve Hawaii's living marine resources. Establishing a task force to identify the problems, and propose agreeable solutions, would improve the data base used in future stock assessments and further ongoing cooperative efforts between State and Federal agencies.

Figure 27. American Samoa's EEZ and 50-Mile Limit



AMERICAN SAMOA

American Samoa consists of six islands, and nearby banks (Figure 27). Fishing data comes from a single source, the American Samoa Department of Marine and Wildlife Resources (DMWR). The data collecting system used by DMWR was significantly modified in October 1985, and a new processing system was needed to standardize the data bases. This new processing system was recently completed by the Western Pacific Fishery Information Network (WPACFIN). For this reason, new data summaries for years 1982-1987 are included in this 1987 report. The updated summaries have been adjusted to account for the percent coverage of the different sampling programs.

Caution should be used when interpreting the data and comparing between the years because: 1) differences still exist between the data sets for which adjustments cannot be made; 2) it was not possible to use identical procedures for all years because of differences and inadequacies of some data. Some mixing of "apples and oranges" which may affect specific numbers was therefore inevitable. But overall trends in the fishery should not be affected. For example, some analyses use data only from trips which fished exclusively for bottomfish. Other analyses also include trips which mixed bottomfish fishing and trolling activities, and still others are based on species caught (irrespective of method of capture). The figures, tables and results presented here are from Hamm and Quach (in press); results are preliminary, and subject to change. For a complete description of the data collecting and processing systems, and for additional detailed data, see Hamm and Quach (1988).

I. STATUS OF THE FISHERY

A. Overview

American Samoa bottomfish landings in 1987 totaled 29,625 pounds, which is approximately 30% of the estimated maximum sustainable yield for American Samoa. These total landings generated an ex-vessel revenue of $44,956. A total of 26 vessels fished for bottomfish during 1987. Although bottomfish landings and fleet size decreased in 1987, catch per hour increased. It is difficult to say which species dominated the catch, because most of the bottomfish catch was not identified to species level.

Bottomfish fishing effort has been declining steadily in recent years. A hurricane in the Manu'a Islands caused the direct loss of some bottomfish fishing vessels, but the major reason for the decline in overall bottomfish fishing effort is probably a result of economic factors. The shift in emphasis in recent years of DMWR toward fisheries management has caused a

decline in the number of government subsidized fishery development programs and a subsequent decrease in the number of "part-time" commercial fishermen. Employment with the American Samoa Government is relatively lucrative and much easier than making a living with a small commercial fishing vessel. This is especially true considering the consistently low ex-vessel price of fresh fish that is maintained due to the availability of large quantities of frozen wahoo and bigeye tuna from the canneries. Declines in CPUE of target bottomfish species (onaga, ehu, opakapaka) in the early 1980's also caused a significant decline in bottomfish fishing effort for the fresh fish export market. Some of these vessels remain active in the local fishery but target on PMUS.

The recent increase in CPUE for the remaining bottomfish fishing fleet is apparently a result of the decrease in effort on local bottomfish stocks and a higher skill level of the remaining fishermen. However, these relationships require a great deal of study and evaluation. This increase in CPUE should not be taken as an automatic indication of a healthy fishery in need of little management as experience has shown the susceptibility of the offshore pinnacles and banks to over exploitation.

B. Total Landings and Trends

1. Total Pounds Landed

Bottomfish landings dropped in 1987 to the lowest on record (Figure 28). Landings of the bottomfish management unit species (BMUS) are declining both in total landings and in percent of the total commercial fishery (Figure 29).

2. Bottomfish Catch Compared to Other Fisheries

Historically, the bottomfish fishery of American Samoa has been an important fishery, making up as much as 50% of the total commercial catch (Figure 30). Graphs of annual trends (in pounds and dollars) of total commercial landings for 1982-1987 are found in Figure 31. The estimated total pounds of commercial landings for 1987 were the smallest recorded since 1982, and as stated above, the percent of the total commercial landings attributable to BMUS has declined significantly during 1987.

The relative importance of the bottomfish fishery compared to the tuna and pelagic management unit species (PMUS) fisheries is shown in Figure 32. Tuna landings (pounds) were considerably higher than either bottomfish or other pelagic species in 1987, but landings of all three species groupings dropped from 1986.

Figure 28. American Samoa bottomfish landings: 1982-87

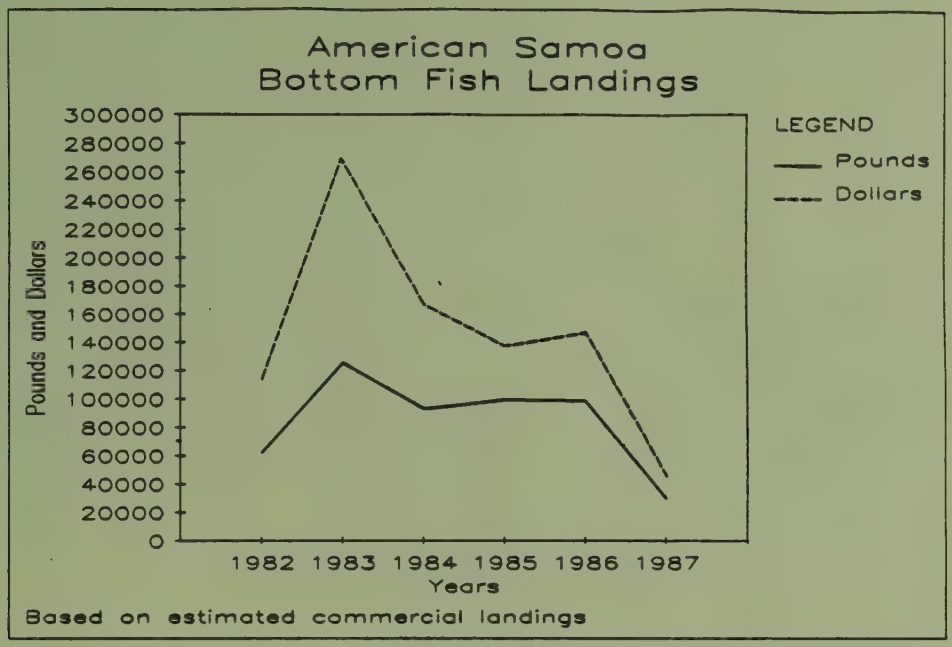


Figure 29. Linear regression of bottomfish catch total BMUS and percent BMUS of total: 1982-87

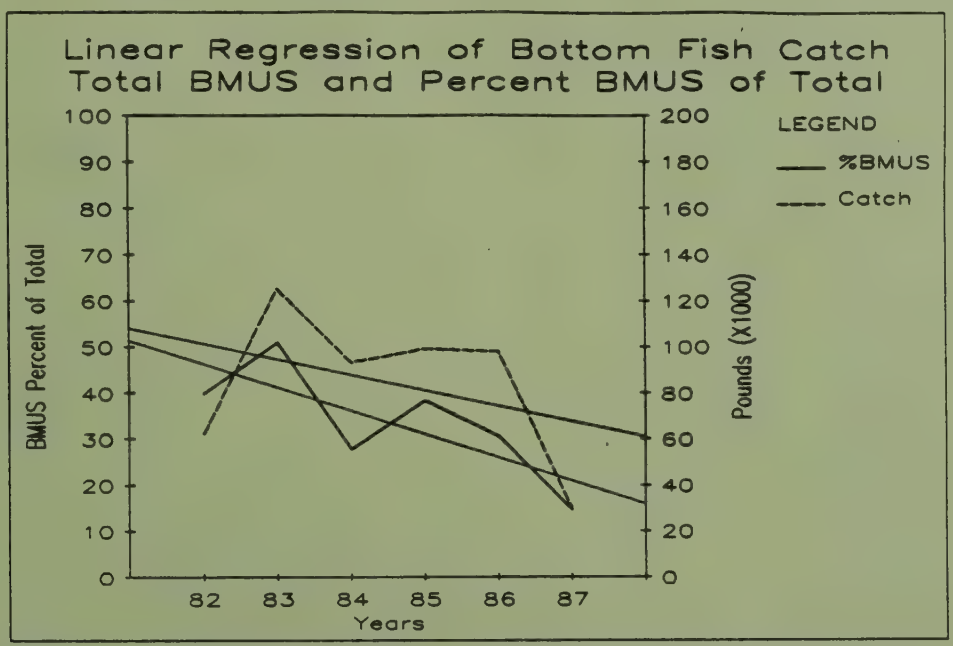


Figure 30. Annual trends in American Samoa's various fisheries: 1982-87

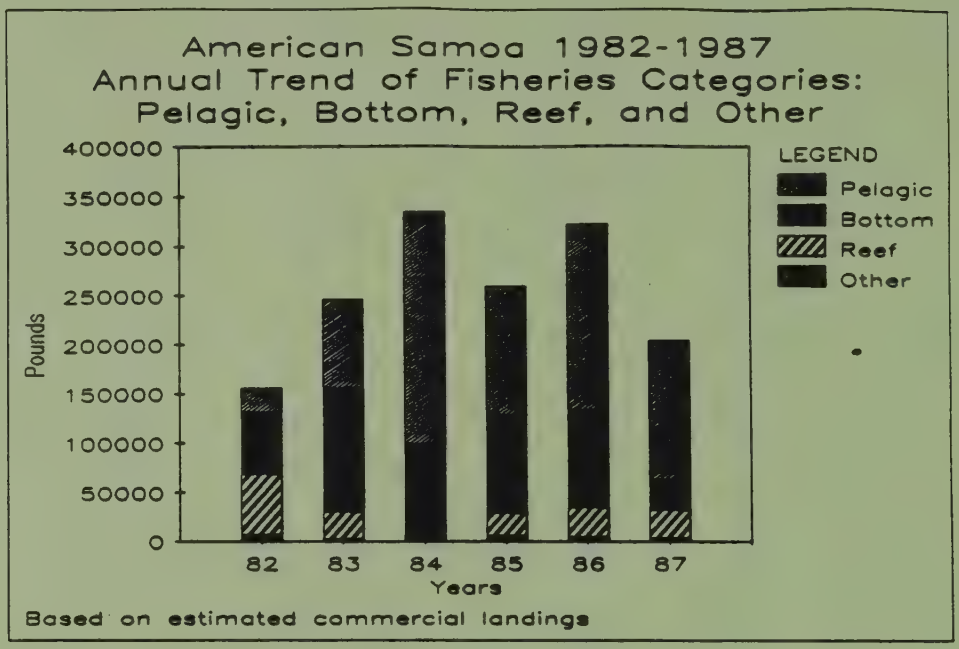


Figure 31. Annual trends in American Samoa's total commercial landings: 1982-87

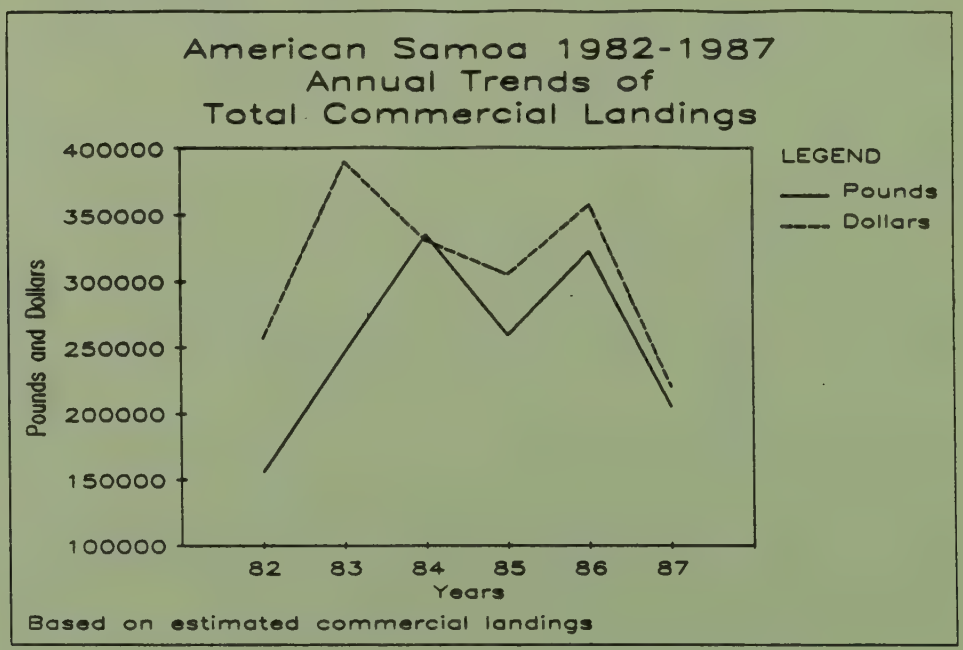
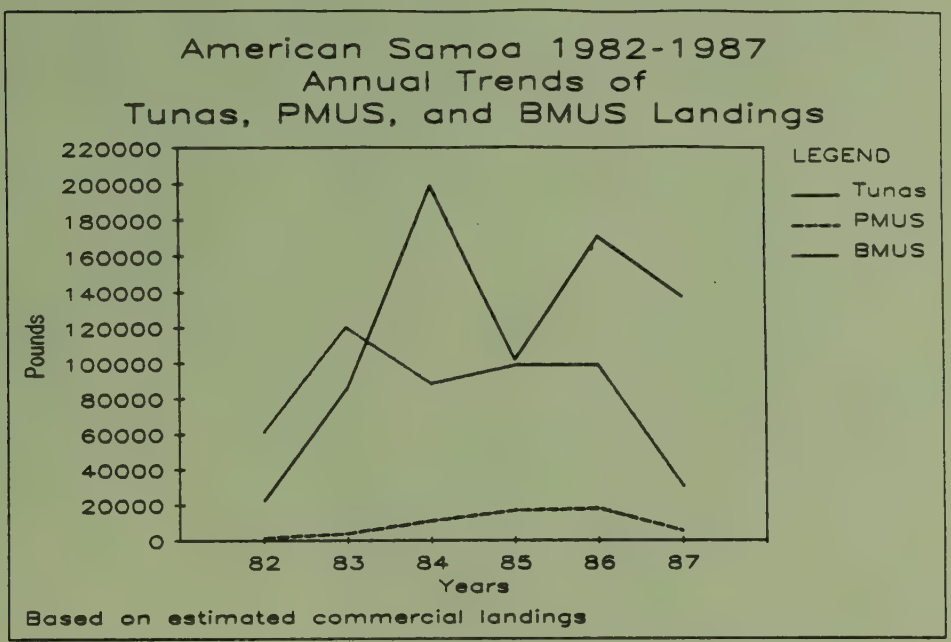


Figure 32. Annual trend of tuna, PMUS, and BMUS landings in American Samoa: 1982-87



C. Revenue and Other Economic Indicators

The total value of the 1987 bottomfish catch declined in 1987 (Figure 28), as did the value of total commercial landings (Figure 31). The declining revenues mirror the declining landings. The value and price per pound by species for 1982-1987 are shown in Tables 14-19. Opakapaka, onaga, and gindai received the highest average price per pound in 1987 and previous years.

D. Fishing Effort

1. Fleet Dynamics

The commercial fishing fleet steadily increased from 1982 tc a peak of 46 vessels in 1985, then drastically declined in 1986 and 1987 to only 18 vessels (Table 20, Figure 33). A portion of the 1987 decline is a direct result of a hurricane that eliminated all of the Manu'a Islands' fleet. The 61% reduction in the active fishing fleet between 1985 and 1987 corresponds with a 70% reduction in bottomfish landings and the 21% reduction in total commercial landings.

2. Number of Trips and CPUE

The number of bottomfish fishing trips made during a year generally corresponds with the number of vessels in the fleet (Figure 33). Two premises were made when calculating the estimated number of fishing trips per year; 1) that all landings made by a vessel on a given day are the result of a single trip; and 2) that all trips involving bottomfish fishing are included, even if trolling was also conducted during the same trip. On the other hand, exclusive bottomfish fishing trips were used to calculate the average trip length and catch per hour (Table 20 and Figure 34).

Figure 34 shows a somewhat different picture of the bottomfish fishery than earlier figures which depict a severely declining fishery. The recorded catch per hour has been increasing since 1985, which may be a result of 1) decrease in fleet size leading to improved fishing for remaining vessels; 2) higher skill level and increased experience of remaining commercial fishermen; 3) the location of a highly productive offshore fishing bank; and 4) a possible shift in fishing effort to target PMUS. The overwhelming decrease in the total bottomfish landings for this period may be a result of many vessels leaving the fishery and a decline in BMUS fishing effort for those vessels remaining active, as opposed to a serious decline in the bottomfish resource. However, additional information and analyses are needed to investigate these relationships.

Table 14. American Samoa 1982 annual estimated commercial bottomfish landings

SPECIES	POUNDS	VALUE	$/LB
JACKS	139.00	244.00	1.76
BLACK JACK	20.00	35.00	1.75
BOTTOM FISH	50294.00	87870.00	1.75
GROUPERS	141.00	247.00	1.75
FLAGTAIL GROUPER	10.00	17.00	1.70
GIANT GROUPER	282.00	282.00	1.00
LUNARTAIL GROUPER	504.00	881.00	1.75
BLUE LINED SNAPPER	1209.00	2115.00	1.75
ONESPOT SNAPPER	7.00	9.00	1.29
HUMPBACK SNAPPER	561.00	981.00	1.75
GRAY JOBFISH	230.00	433.00	1.88
DEEPWATER BOTTOMFISH	2349.00	6977.00	2.97
YELLOW OPAKAPAKA	40.00	60.00	1.50
HAWAIIAN OPAKAPAKA	68.00	118.00	1.74
OPAKAPAKA	406.00	811.00	2.00
BLUE LINED GINDAI	13.00	22.00	1.69
GINDAI (FLOWER SNAP)	82.00	139.00	1.70
LEHI (SILVERJAW)	216.00	370.00	1.71
ONAGA (RED SNAPPER)	1002.00	3796.00	3.79
EHU (RED SNAPPER)	1345.00	2851.00	2.12
EMPERORS (MISC)	2910.00	5090.00	1.75
LONGNOSE EMPEROR	150.00	263.00	1.75
BLUELINE BREAM	21.00	37.00	1.76
SNAKE MACKEREL	17.00	30.00	1.76
** Total Bottom Fish**	62016.00	113678.00	
** TOTAL ALL SPECIES**	155949.00	256455.00	

Table 15. American Samoa 1983 annual estimated commercial bottomfish landings

SPECIES	POUNDS	VALUE	$/LB
JACKS	1962.00	3344.00	1.70
BLACK JACK	151.00	193.00	1.28
BIGEYE TREVALLY	19.00	11.00	0.57
BLUEFIN TREVALLY	6.00	6.00	1.00
AMBERJACK	111.00	194.00	1.75
BOTTOM FISH	77359.00	135296.00	1.75
GROUPERS	1705.00	2978.00	1.75
FLAGTAIL GROUPER	4.00	6.00	1.50
TOMATO GROUPER	167.00	253.00	1.51
BLACKTIP GROUPER	6.00	10.00	1.67
STRIPED GROUPER	22.00	52.00	2.36
GIANT GROUPER	348.00	359.00	1.03
LUNARTAIL GROUPER	198.00	347.00	1.75
SNAPPERS	52.00	65.00	1.25
BLUE LINED SNAPPER	2973.00	4872.00	1.64
BLACKTAIL SNAPPER	111.00	158.00	1.42
ONESPOT SNAPPER	342.00	543.00	1.59
TWINSPOT/RED SNAPPER	259.00	372.00	1.44
HUMPBACK SNAPPER	1174.00	2053.00	1.75
BROWN JOBFISH	52.00	90.00	1.73
GRAY JOBFISH	5943.00	14598.00	2.46
YELLOW OPAKAPAKA	1618.00	6575.00	4.06
HAWAIIAN OPAKAPAKA	173.00	454.00	2.62
GINDAI (FLOWER SNAP)	918.00	2018.00	2.20
YELLOWTAIL SNAPPER	13.00	14.00	1.08
LEHI (SILVERJAW)	4512.00	10246.00	2.27
ONAGA (RED SNAPPER)	13738.00	60254.00	4.39
EHU (RED SNAPPER)	5808.00	14450.00	2.49
STONE'S SNAPPER	2039.00	3396.00	1.67
KUSAKAR'S SNAPPER	25.00	45.00	1.80
EMPERORS (MISC)	3253.00	5679.00	1.75
LONGNOSE EMPEROR	65.00	81.00	1.25
SNAKE MACKEREL	41.00	71.00	1.73
** Total Bottom Fish**	125167.00	269083.00	
** TOTAL ALL SPECIES**	245937.00	389077.00	

Table 16. American Samoa 1984 annual estimated commercial bottomfish landings

SPECIES	POUNDS	VALUE	$/LB
JACKS	1909.00	3171.00	1.66
BLACK JACK	15.00	24.00	1.60
TREVALLY	14.00	24.00	1.71
BOTTOM FISH	61063.00	97425.00	1.60
GROUPERS	1510.00	2621.00	1.74
BLACKTIP GROUPER	10.00	17.00	1.70
GIANT GROUPER	243.00	302.00	1.24
LUNARTAIL GROUPER	564.00	986.00	1.75
SNAPPERS	128.00	200.00	1.56
BLUE LINED SNAPPER	3713.00	5991.00	1.61
RUFOUS SNAPPER	122.00	190.00	1.56
BLACKTAIL SNAPPER	546.00	797.00	1.46
ONESPOT SNAPPER	381.00	591.00	1.55
TWINSPOT/RED SNAPPER	585.00	1020.00	1.74
HUMPBACK SNAPPER	1698.00	2952.00	1.74
GRAY JOBFISH	1521.00	2494.00	1.64
DEEPWATER BOTTOMFISH	163.00	369.00	2.26
YELLOW OPAKAPAKA	1193.00	2838.00	2.38
HAWAIIAN OPAKAPAKA	1043.00	3552.00	3.41
OPAKAPAKA	40.00	69.00	1.73
GINDAI (FLOWER SNAP)	1729.00	2923.00	1.69
YELLOWTAIL SNAPPER	3.00	2.00	0.67
LEHI (SILVERJAW)	1227.00	3232.00	2.63
ONAGA (RED SNAPPER)	4282.00	17026.00	3.98
EHU (RED SNAPPER)	4291.00	9764.00	2.28
BLACK SNAPPER	40.00	69.00	1.73
STONE'S SNAPPER	834.00	1454.00	1.74
KUSAKAR'S SNAPPER	108.00	189.00	1.75
BIGEYE EMPEROR	7.00	12.00	1.71
EMPERORS (MISC)	3740.00	6460.00	1.73
LONGNOSE EMPEROR	111.00	139.00	1.25
SNAKE MACKEREL	8.00	14.00	1.75
** Total Bottom Fish**	92841.00	166917.00	
** TOTAL ALL SPECIES**	334746.00	330424.00	

Table 17. American Samoa 1985 annual estimated commercial bottomfish landings

SPECIES	POUNDS	VALUE	$/LB
JACKS	467.00	671.91	1.44
BLACK JACK	80.00	166.73	2.08
BIGEYE TREVALLY	95.00	118.75	1.25
BOTTOM FISH	85230.00	109570.77	1.29
GROUPERS	173.00	295.50	1.71
TOMATO GROUPER	196.00	245.00	1.25
BLACKTIP GROUPER	13.00	16.25	1.25
LUNARTAIL GROUPER	397.00	578.21	1.46
SNAPPERS	43.00	65.26	1.52
BLUE LINED SNAPPER	553.00	769.31	1.39
BLACKTAIL SNAPPER	51.00	63.74	1.25
ONESPOT SNAPPER	57.00	88.54	1.55
TWINSPOT/RED SNAPPER	7.00	12.24	1.75
HUMPBACK SNAPPER	269.00	429.61	1.60
GRAY JOBFISH	534.00	838.29	1.57
DEEPWATER BOTTOMFISH	649.00	957.05	1.47
YELLOW OPAKAPAKA	522.00	889.83	1.70
HAWAIIAN OPAKAPAKA	456.00	1656.54	3.63
OPAKAPAKA	168.00	209.75	1.25
BLUE LINED GINDAI	125.00	187.50	1.50
GINDAI (FLOWER SNAP)	1211.50	1853.88	1.53
YELLOWTAIL SNAPPER	5.00	9.00	1.80
LEHI (SILVERJAW)	396.00	1554.47	3.93
ONAGA (RED SNAPPER)	2139.50	7331.14	3.43
EHU (RED SNAPPER)	4382.00	6719.41	1.53
BLACK SNAPPER	27.00	33.75	1.25
STONE'S SNAPPER	143.00	200.00	1.40
KUSAKAR'S SNAPPER	18.00	22.50	1.25
EMPERORS (MISC)	730.00	1126.35	1.54
LONGNOSE EMPEROR	80.00	100.00	1.25
** Total Bottom Fish**	99217.00	136781.28	
** TOTAL ALL SPECIES**	259267.00	304864.62	

Table 18. American Samoa 1986 annual estimated commercial bottomfish landings

SPECIES	POUNDS	VALUE	$/LB
JACKS	615.00	803.36	1.31
BLACK JACK	388.00	582.00	1.50
BOTTOM FISH	84384.00	107122.50	1.27
GROUPERS	128.00	192.00	1.50
TOMATO GROUPER	157.00	235.49	1.50
LUNARTAIL GROUPER	232.00	335.76	1.45
SNAPPERS	126.00	252.00	2.00
BLUE LINED SNAPPER	340.00	497.70	1.46
ONESPOT SNAPPER	98.25	147.19	1.50
TWINSPOT/RED SNAPPER	47.00	70.50	1.50
HUMPBACK SNAPPER	167.00	227.25	1.36
GRAY JOBFISH	315.00	882.50	2.80
DEEPWATER BOTTOMFISH	1157.00	1773.25	1.53
YELLOW OPAKAPAKA	490.00	847.00	1.73
HAWAIIAN OPAKAPAKA	342.00	1402.00	4.10
GINDAI (FLOWER SNAP)	568.00	1169.00	2.06
LEHI (SILVERJAW)	666.00	2152.00	3.23
ONAGA (RED SNAPPER)	3921.00	17863.00	4.56
EHU (RED SNAPPER)	4177.00	10084.17	2.41
EMPERORS (MISC)	118.50	177.75	1.50
** Total Bottom Fish**	98436.75	146816.42	
** TOTAL ALL SPECIES**	322296.70	357515.31	

Table 19. American Samoa 1987 annual estimated commercial bottomfish landings

SPECIES	POUNDS	VALUE	$/LB
JACKS	94.00	131.00	1.39
BLACK JACK	33.00	52.00	1.58
BOTTOM FISH	28425.00	42217.00	1.49
GROUPERS	14.00	21.00	1.50
TOMATO GROUPER	27.00	40.50	1.50
LUNARTAIL GROUPER	34.00	51.00	1.50
BLUE LINED SNAPPER	150.00	233.50	1.56
ONESPOT SNAPPER	7.00	10.50	1.50
HUMPBACK SNAPPER	34.00	44.50	1.31
GRAY JOBFISH	25.00	37.50	1.50
YELLOW OPAKAPAKA	52.00	208.00	4.00
GINDAI (FLOWER SNAP)	38.00	144.00	3.79
LEHI (SILVERJAW)	81.00	175.00	2.16
ONAGA (RED SNAPPER)	232.00	881.00	3.80
EHU (RED SNAPPER)	298.00	581.50	1.95
EMPERORS (MISC)	16.00	24.00	1.50
AMBON EMPEROR	65.00	104.00	1.60
** Total Bottom Fish**	29625.00	44956.00	
** TOTAL ALL SPECIES**	204921.00	219522.50	

Table 20. American Samoa bottomfish catch and effort: 1982-87

	1982	1983	1984	1985	1986	1987
Estimated Number of Bottom Fish Trips	594	652	662	834	738	233
Number of Vessels Landing Bottom Fish	21	26	35	46	33	18
Average Bottom Fish Trip Length (hrs)	13.5	17.6	14.7	14.6	15.3	11.3
Average Catch per Hour	8.2	11.1	9.9	8.0	9.2	12.4

Figure 33. American Samoa bottomfish fleet: 1982-87

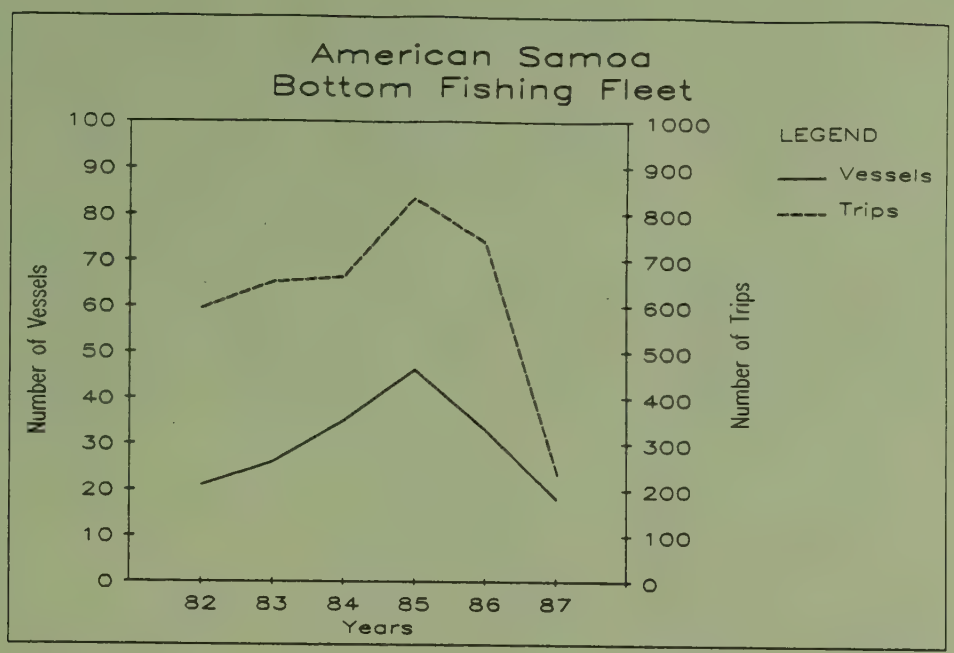
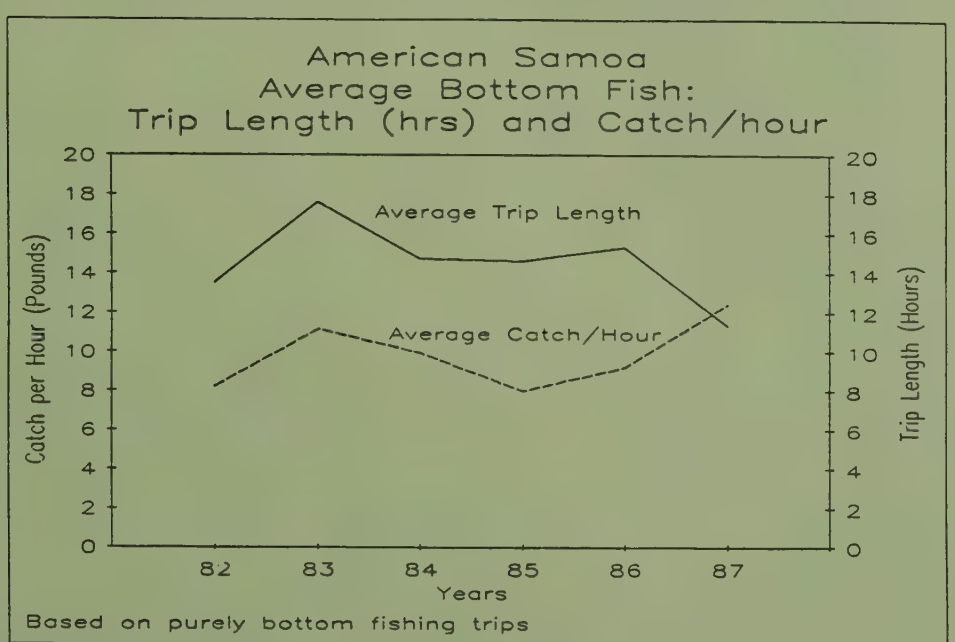


Figure 34. American Samoa average bottomfish effort: 1982-87



E. Characteristics of the Catch

1. Geographical and Seasonal Variations

Since 1982, the specific fishing area has been recorded for the majority of the bottomfish fishing trips. (See Figure 35 for area "code"). As expected, the areas closest to Tutuila (which is where most of the boats are) have been the most heavily fished, making up almost 90% of the total catch (Table 21). Over the six year period, area 33 was the most productive, followed by area 36 and then, area 31.

Generally speaking, bottomfish landings in American Samoa are higher from March through October. The apparent three peak periods during the year (Figure 36) are unexplained as yet. The seasonality of the bottomfish fishery is compared to two other fisheries (tuna and pelagics) in Figure 37.

2. Species Composition

It is difficult to analyze species composition of the catch because of problems with the data base. The DMWR data collectors obtain individual species identifications on only a small portion of the total bottomfish catch. The unidentified portion of the bottomfish catch has grown from 61% in 1983, the best year on record, to 96% in 1987, the worst year on record. Because of the low level of specific identification, extra caution is advised in interpreting the results of any species composition comparisons. Serious efforts should be made to increase the identification of bottomfish catches in American Samoa to the species level. Total pounds landed for each species or group (1982-1987) is shown in Tables 14-19.

If one assumes that identified catches are representative of the true percent species composition in the fishery, the unidentified catch can be allocated appropriately to individual species. Cursory analysis of six of the major species; taape, uku, lehi (Figure 38), onaga, ehu, and emperors (Figure 39), show no obvious trends or changes in species composition.

F. Biological Assessment of the Landings

Using a market-sampling program, the DMWR staff began collecting size-frequency data for selected bottomfish species in 1987. These data were not available for analysis in Honolulu when this report was written. Analysis will be done when data become available.

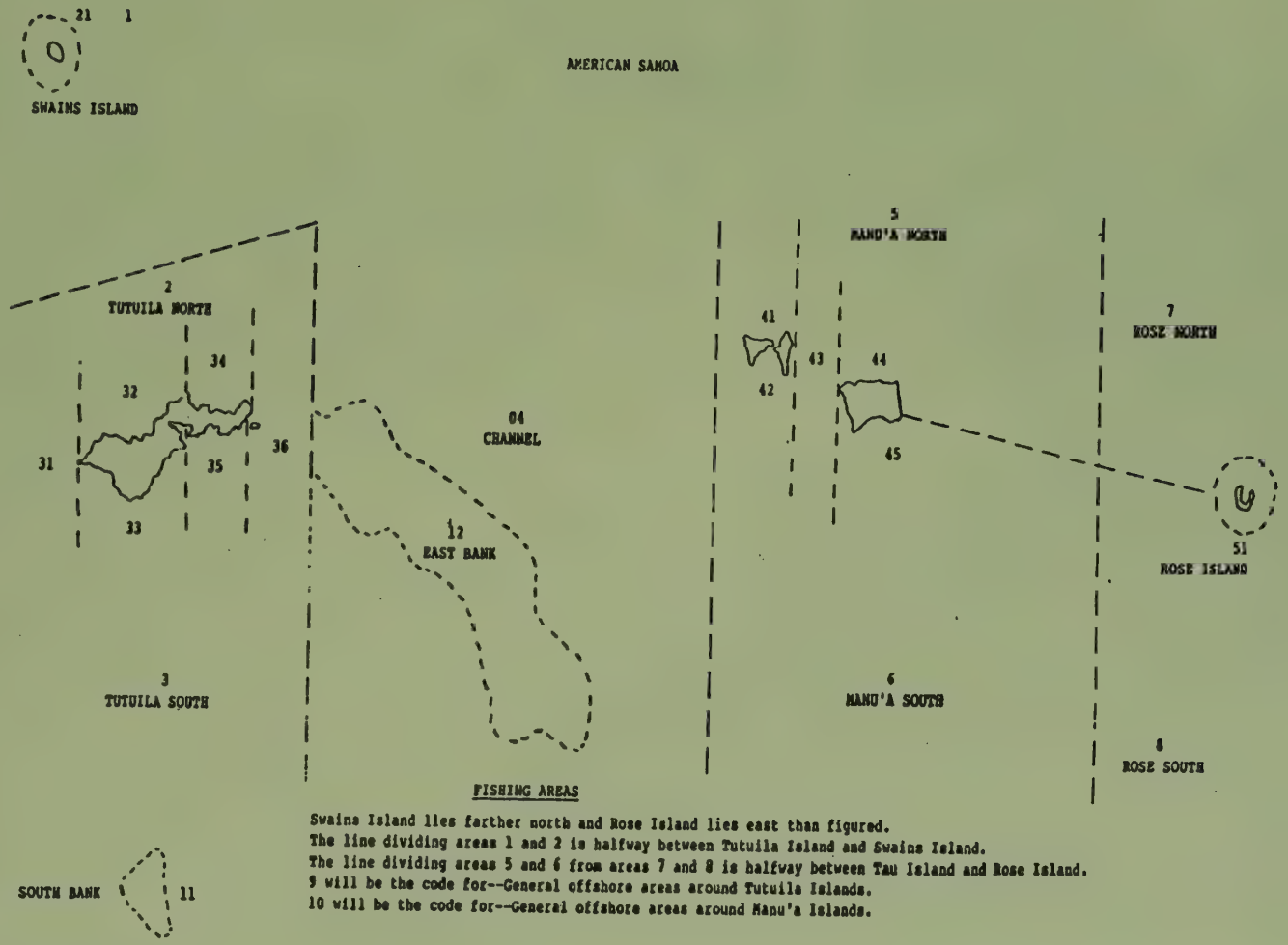


Figure 35. Fishing areas for American Samoa.

Table 21. Percent of bottomfish catch by area fished (includes exclusively bottomfishing trips; excludes trolling trips): 1982-87.

Area	1982	1983	1984	1985	1986	1987
2	0	2.3	1.4	3.1	0.5	0
3	1.3	1.3	8.9	8.4	6.5	4.2
4	0	0	0.4	0	5.6	0
9	0	5.7	15.5	11.8	14.2	3.9
10	0	0.1	3.7	2.2	8.0	10.8
11	0	0	0.9	0	0	0
12	0	10.7	2.4	0.2	6.9	3.6
20	0	0	0	0.3	0	0
31	3.4	15.9	25.6	23.0	7.4	11.1
32	2.6	7.9	4.6	16.2	5.5	3.6
33	49.2	15.7	3.1	8.8	15.1	40.3
34	3.1	4.7	6.5	2.3	2.6	12.6
35	31.8	9.8	1.6	1.3	6.2	0
36	8.6	22.8	25.1	18.6	17.4	9.9
41	0	0.7	0	0	0	0
42	0	2.0	0.3	0.3	0	0
43	0	0.2	0	3.4	2.4	0
44	0	0	0	0	1.2	0
45	0	0	0	0	0.6	0

Figure 36. Average monthly landing of BMUS, onaga, and ehu in American Samoa: 1982-87.

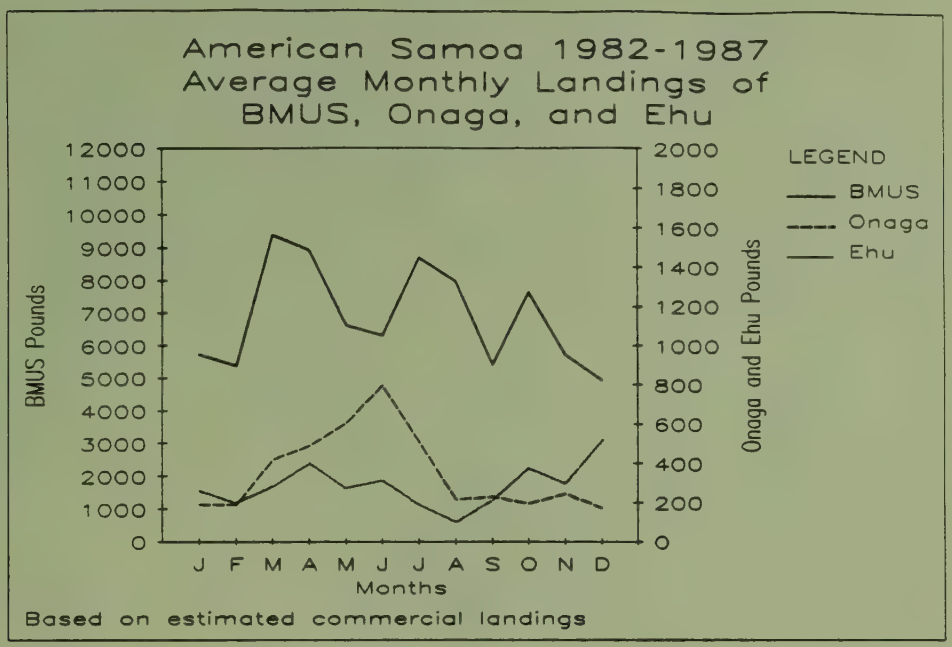


Figure 37. Average monthly landings of tuna, PMUS, and BMUS in American Samoa: 1982-87.

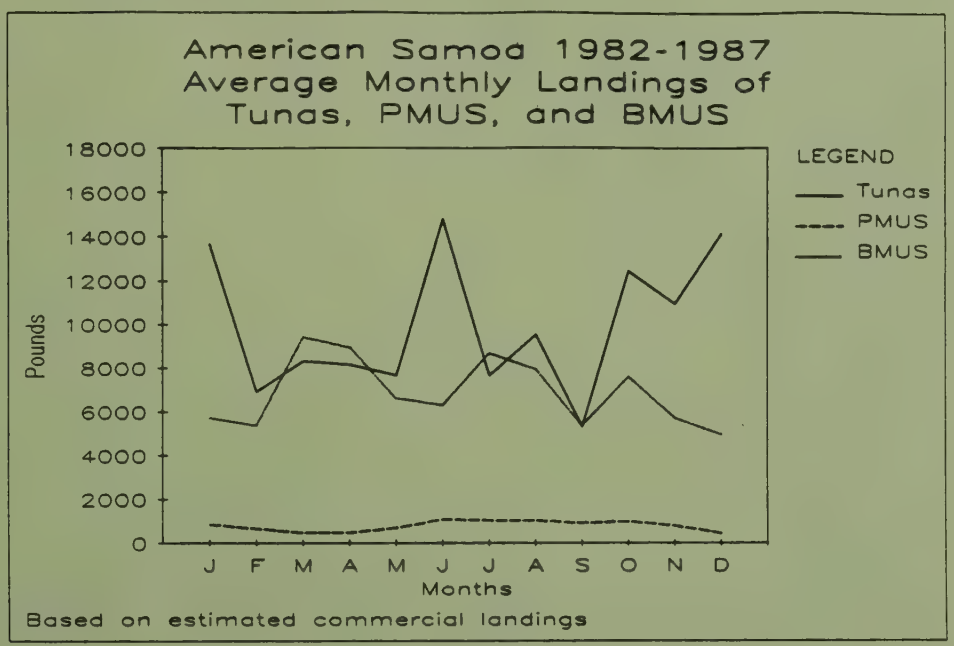


Figure 38. Percent species composition of taape, uku, and lehi in American Samoa: 1982-87.

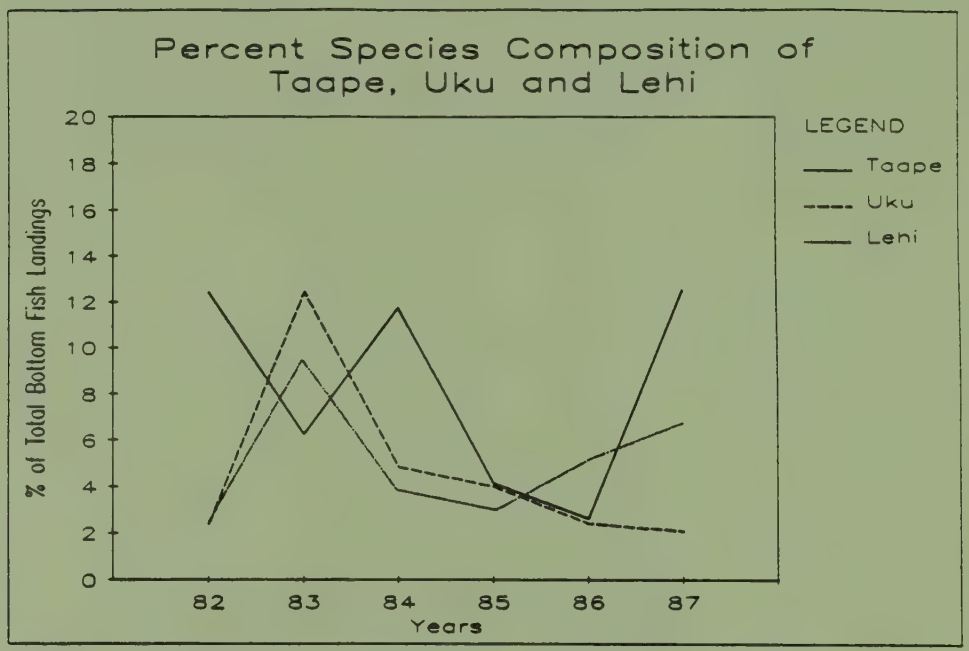
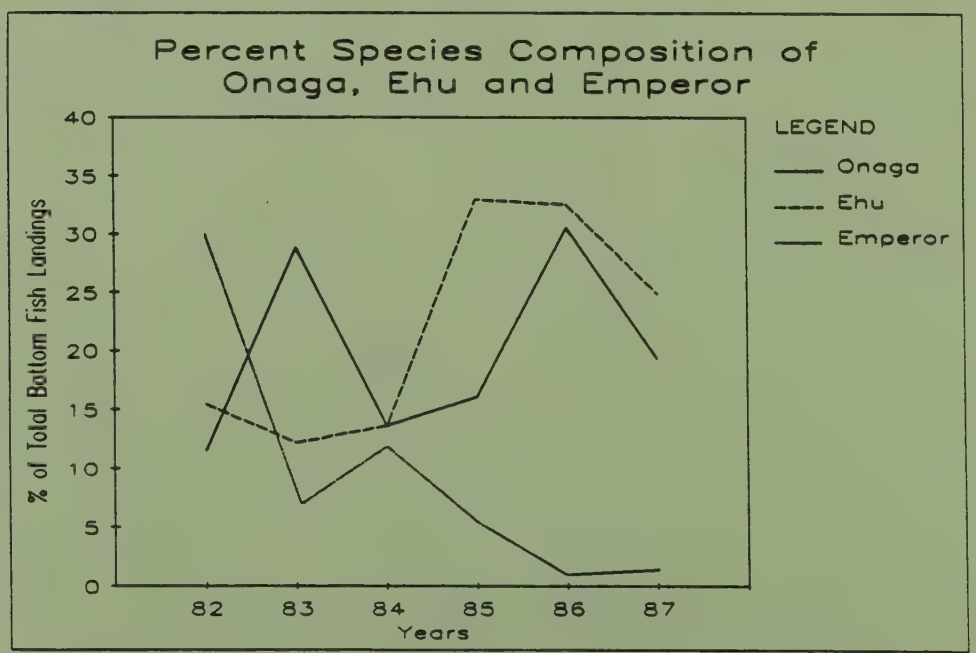


Figure 39. Percent species composition of onaga, ehu, and emperor in American Samoa: 1982-87.



1. Maximum Sustainable Yield (MSY)

No rigorous evaluation for the sustainable yield from American Samoa's bottomfish resources has been conducted. However, an MSY estimate for the area was determined by scientists at the NMFS Honolulu Laboratory by using the 200-meter isobath as an approximation of bottomfish habitat and area productivity. Using a value of 143.3 nautical miles of 200-meter depth contour around American Samoa, the maximum sustainable yield for the region was estimated at 45 metric tons (99,000 pounds) per year. Commercial bottomfish landings recorded for American Samoa between 1984 and 1986 were essentially achieving this estimated MSY. However, in 1987 bottomfish total landings drastically dropped to only 30% of this MSY estimate for American Samoa.

G. Summary Table of Fishery Status

Status of the American Samoa Bottomfish Fishery

Problem Condition	Present in the Bottomfish Fishery	Comment
1. Age at entry is prereproduction	Data unavailable	
2. Unacceptable ratio of fish-mortality to natural mortality	Data unavailable	
3. Catch exceeds maximum sustainable yield	Not indicated	As compared to habitat based MSY estimate.
4. Significant decline in CPUE	Not indicated	More analyses are needed.
5. Substantial decline in ex-vessel revenue relative to baseline levels	Data available next year	WPRFMC/DMWR/ NMFS economic fishing vessel survey now under way.
6. Significant shift in gear, by area	Not indicated	

Status of the American Samoa Bottomfish Fishery (...cont.)

Problem Condition	Present in the Bottomfish Fishery	Comment
7. Significant change in the frozen/fresh components of catch	Data unavailable	Will be available beginning January 1989.
8. Unstable pattern of entry/exit to the fishery	Yes	Recent decline in number of boats.
9. Per trip costs exceed per trip revenues	Data available next year	WPRFMC/DMWR/ NMFS economic fishing survey now under way.
10. Significant decline or increase in total bottomfish landings	Yes	Decline
11. Change in species composition of catch	Not indicated	Better species ID and further analysis are needed.
12. Research results indicate problems	Not indicated	Additional data and analyses needed.
13. Habitat degradation or environmental problems	Data unavailable	Hurricane in 1987; total effect unknown.
14. Increased interaction with protected species	Not indicated	

II. RECENT RESEARCH

In late 1987 the Council, DMWR, and NMFS began a collaborative project to design, field, and evaluate the result from an economic survey of small-scale commercial bottomfish fishermen in American Samoa. The Council contracted DMWR to obtain completed questionnaires by personally interviewing fishermen in American Samoa. Similar surveys were conducted in the CNMI and Guam. The NMFS Honolulu Laboratory will computerize the survey data and produce a final report on the economic condition of the bottomfish fishery in each of these areas. The bulk of the work would occur in 1988, therefore, results will be forthcoming in the 1988 annual report.

Other research related to American Samoa's bottomfish resources within water under Federal jurisdiction, would include the ongoing WPACFIN program. Data collection efforts through WPACFIN made possible the majority of information presented in this report's section on American Samoa.

III. HABITAT CONDITIONS AND RECENT ALTERATIONS

A hurricane in January 1987 destroyed the fishing fleet in the Manu'a Islands. DMWR reef surveys indicated no significant damage to coral reef areas as a result of storm swells in this area. However, some locations were impacted by sediment discharge from increased erosion. Farther to the north, large storm swells destroyed a high percentage of formerly pristine coral reefs located around Swains Island. DMWR surveys indicated a significant loss of reef habitat and a decrease in shallow water snappers, jacks, barracuda, etc. The scourging effect of tons of coral rubble that fell downslope of the damaged areas may have had a negative impact on bottomfish habitat. Residents have been warned of the possibility of an increase in ciguatera fish poisoning but no increase has been noted.

IV. ENFORCEMENT ACTIVITIES AND PROBLEMS

No problems of enforcement were identified by NMFS or DMNR.

V. NMFS ADMINISTRATIVE ACTIONS

No administrative actions were identified by NMFS.

VI. STATE/TERRITORIAL MANAGEMENT ACTIONS

The American Samoa Office of Marine and Wildlife Resources (OMWR), as it was called in the 1986 annual report, has changed

its title and is now called the American Samoa Department of Marine and Wildlife Resources (DMWR). A comprehensive set of fishing and conservation regulations have been drafted and reviewed. Full adoption and enforcement of these regulations will begin January 1989. The regulations will also require mandatory reporting of catches and sales of all imported and locally caught seafood. Also, the DMWR has redesigned their fisheries form (to be used in 1988) such that it includes a list of bottomfish species to be used as a reference by fishermen. This should result in better species identification and recording.

VII. COUNCIL ACTIONS

A. Assessment of Need for Council Action

Assessment of need for Council action is summed up below in "Recommendations for Council Action".

B. Recommendations for Council Action

The BPMT has made the following three recommendations in regard to American Samoa. For recommendations for other geographic areas within the western Pacific region, see the complete list of BPMT recommendations at the front of this report.

Participation of scientists from American Samoa. The problems of the fisheries for bottomfish in Hawaii have received the most attention from the BPMT to date because the problems have been most intense in Hawaii. The BPMT now expects to devote more attention to the bottomfish fisheries in American Samoa and wishes to have a scientist from this area named to the BPMT. Participation of a scientist from this area would be particularly helpful in evaluating information on the status of the fishery in these locations. The annual review of the bottomfish fishery is the most important function of the Plan Monitoring Team. It is recommended that a representative from American Samoa be named to the BPMT as soon as possible. The team also recommends that the annual review for both the bottomfish and pelagic species plan be held during the same week should the same scientist be named to the Pelagics Plan Monitoring Team.

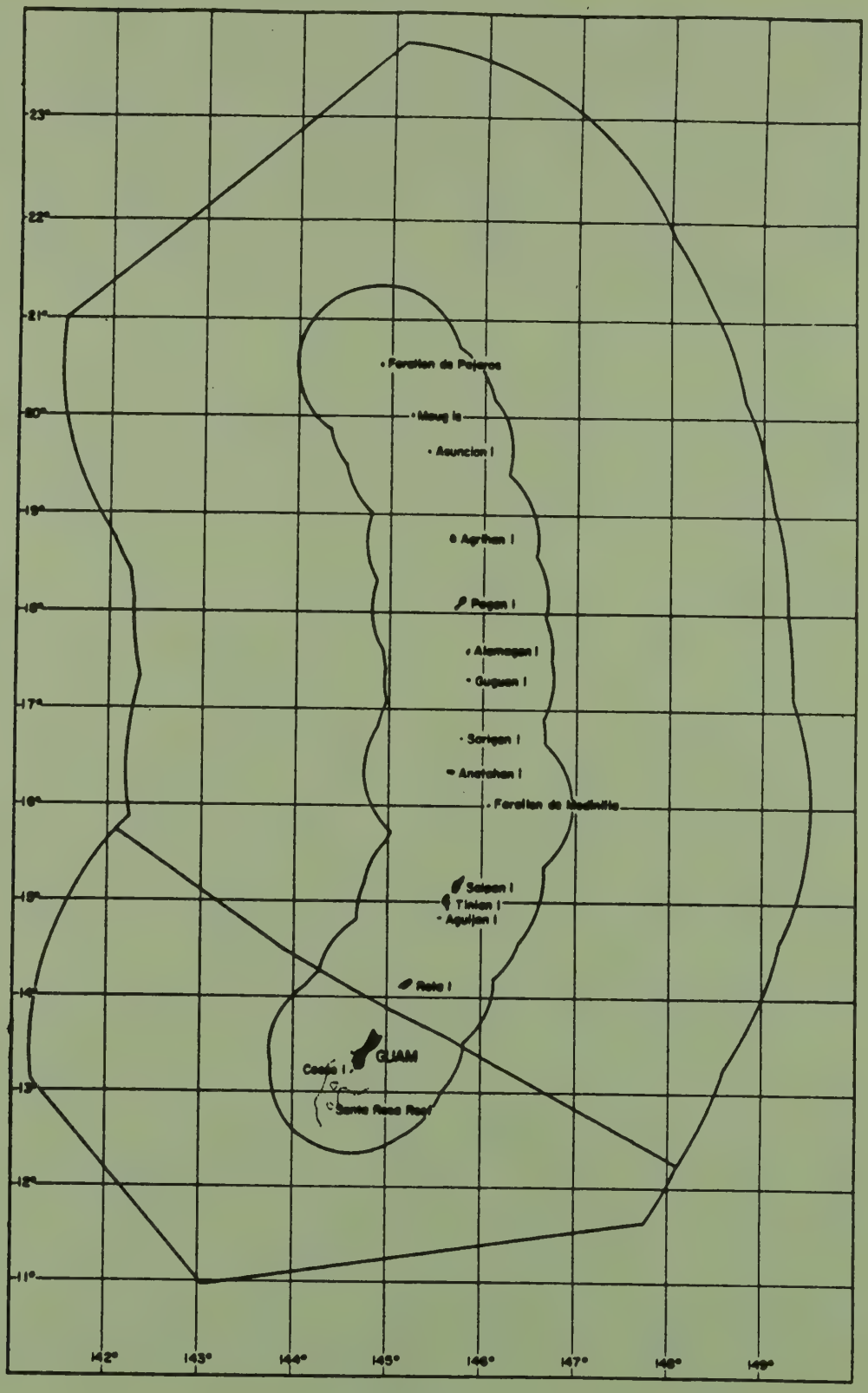
Improved biological statistics for bottomfish stocks in American Samoa. Better species identification and acquisition of extensive size-frequency data is especially important for biological assessment in American Samoa. Further work to improve fishing effort statistics and information concerning the location of catch are highly desirable and should be encouraged.

Continued collaboration between the American Samoa Department of Marine and Wildlife Resources and NMFS on joint assessment of bottomfish stocks in American Samoa. The BPMT feels the recent history of the bottomfish fishery in American Samoa needs to be understood more fully because of its apparent boom-bust cycles. The current collaborative research by the American Samoa Department of Marine and Wildlife Resources and the NMFS Honolulu Laboratory on the status of bottomfish stocks in American Samoa is important to either substantiate or disprove perceived problems in the fishery. Particular attention should be devoted to the susceptibility of localized areas of productive bottomfish habitat (e.g., pinnacles and small banks) to be easily fished out.

C. Estimated Impacts of Recommended Action

By facilitating implementation of the activities recommended, a better understanding of American Samoa's bottomfish fishery will result and it will become apparent whether specific management actions are required for the fishery.

Figure 40. The 50-mile limits and the EEZ around Guam and the CNMI



NORTHERN MARIANA ISLANDS

The Northern Mariana Islands and Guam are broken into two separate areas for reporting purposes (as defined in the Bottomfish Fishery Management Plan). They are part of the same geographic chain of the Mariana Islands (Figure 40).

Fishery data from the Commonwealth of the Northern Mariana Islands (CNMI) comes from a single source; commercial landing data bases of the CNMI's Division of Fish and Wildlife (DFW). The DFW collects "trip ticket" receipts from all major fish purchasers on Saipan; data currently are not collected on Tinian or Rota. The figures, tables and results presented here are from the WPACFIN program of NMFS (Hamm and Quach, in press); results are preliminary, and subject to change.

All analyses presented here are subject to change if additional information becomes available. As such, caution should be used when interpreting the following summary statistics. This is especially true because of the following. The data collection system was significantly improved during 1982. Therefore, data collected prior to 1983 are generally not comparable to data collected from 1983 to the present. Some data prior to and including 1982 have been included here, but the reader is cautioned about its possible noncomparability. Also, the DFW suspects that the percent coverage of major fish purchases may have decreased over the past year or so because there are new retail market businesses with whom DFW has not yet made arrangements for obtaining receipts. DFW is presently checking into this.

In addition, the following should be kept in mind. In this report, the terms fisherman, vessel, and boat all refer to the same fishing "unit". The 1986 annual monitoring team report on the bottomfish fishery for the CNMI omitted emperorfish (from the tables, figures, and analyses), but this year's report includes this group and provides updated information for years back to 1982. For additional background information or specifics on other CNMI fisheries, see Hamm et. al. (1986) and Hamm and Quach (1988).

I. STATUS OF THE FISHERY

A. Overview

The CNMI 1987 bottomfish landings totaled 39,772 pounds (12.7% of the total commercial landings), and had a value of $71,867.91. There is high demand and short supply of bottomfish in the market. A total of 43 vessels participated in bottomfish fishing. Emperorfish, grouper, onaga, and opakapaka were the dominant species in the catch. There is no indication of

problems with the CNMI bottomfish fishery based on changes in species composition. Size-frequency data are not available to help make a biological assessment of the stocks.

B. Total Landings and Trends

1. Total Pounds Landed

The CNMI 1987 bottomfish landings totaled 39,772 pounds (Table 22). Landing trends are discussed in the next section.

2. Bottomfish Catch Compared to Other Fisheries

Similar to Guam, the CNMI's bottomfish fishery comprises a relatively small percentage of the total commercial landings (Figure 41), but culturally and economically is a very important fishery. In 1987, the bottomfish category comprised 12.7% of the total commercial landings, the largest on record. Landings of the bottomfish management unit species (BMUS) are about equal to landings of the pelagic management unit species (PMUS), but the tunas are the most important species in the commercial fisheries (Figure 42). Landings of the BMUS have been as large as or larger than the PMUS every year since 1983.

The total commercial landings increased from 1982 to 1984, dropped considerably in 1985, rose to near-1984 levels in 1986, and then dropped in 1987 to the lowest level since 1982 (Figure 43). Commercial bottomfish landings, however, increased until 1984, leveled off in 1985, dropped in 1986, and increased during 1987 to an all-time high in both total landings and percentage of the total fisheries. The apparent negative correlation between the total landings and the bottomfish landings for 1985-87 may be a result of fisheries interactions. That is, when the tuna fishery is poor, as it was in 1985 and 1987 (Figure 42), more fishermen turn to bottomfish fishing, causing an increase in landings in that fishery. However, the correlation does not hold true for 1984 when both fisheries had peaks.

C. Revenue and Other Economic Indicators

Tables 23-28 provide annual ex-vessel values and average price per pound by species for the bottomfish landed in the CNMI for 1982 to 1987. During 1987, onaga brought the highest price per pound, $2.77. Bottomfish are high in demand and relatively in short supply, so the market generally sells out very rapidly at fairly high prices.

Table 22. Annual CNMI bottomfish statistics: 1982-87

	1982	1983	1984	1985	1986	1987
Total Commercial Landings (lbs)	150763	330752	444559	338428	410025	312186
Bottom Fish Landings	11076	22683	33924	32780	23929	39772
Percent Bottom fish to Total Commercial Landings	7.3%	6.8%	7.6%	9.7%	5.8%	12.7%
Number of Recorded Species Landings	99	673	640	348	297	293
Number of Trips	50	533	492	283	229	237
Number of Fishermen	17	90	102	55	54	43
Bottom Fish Catch/Trip	222	43	69	116	104	168
Catch of Fishermen with > 1000 lbs/yr	10373	10027	21729	24542	17767	33598
Percent of Total Catch by Fishermen Landing > 1000 lbs	94%	44%	64%	75%	74%	84%
Number of Trips by Fishermen Landing>1000 lbs/yr	25	140	252	195	124	134
Number of Fishermen Landing >= 1000 lbs/yr	2	6	8	5	7	6
Catch/Trip for Fishermen Landing 1000 > lbs/yr	415	72	86	126	143	251

Figure 41. Annual trends of fisheries in CNMI: 1979-87

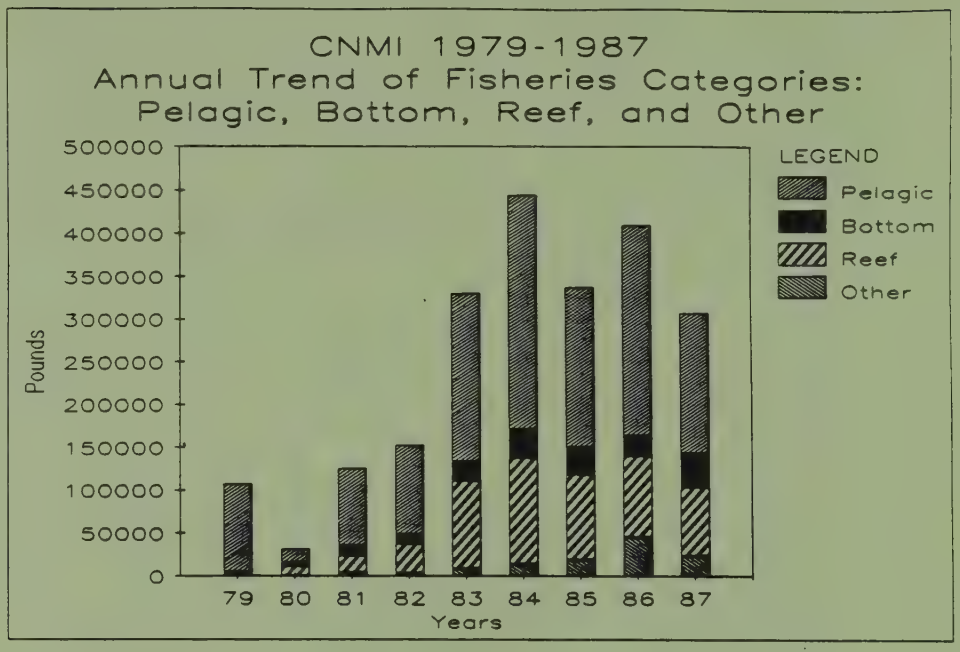


Figure 42. Annual trends of tuna, PMUS, and BMUS landings in CNMI: 1979-87

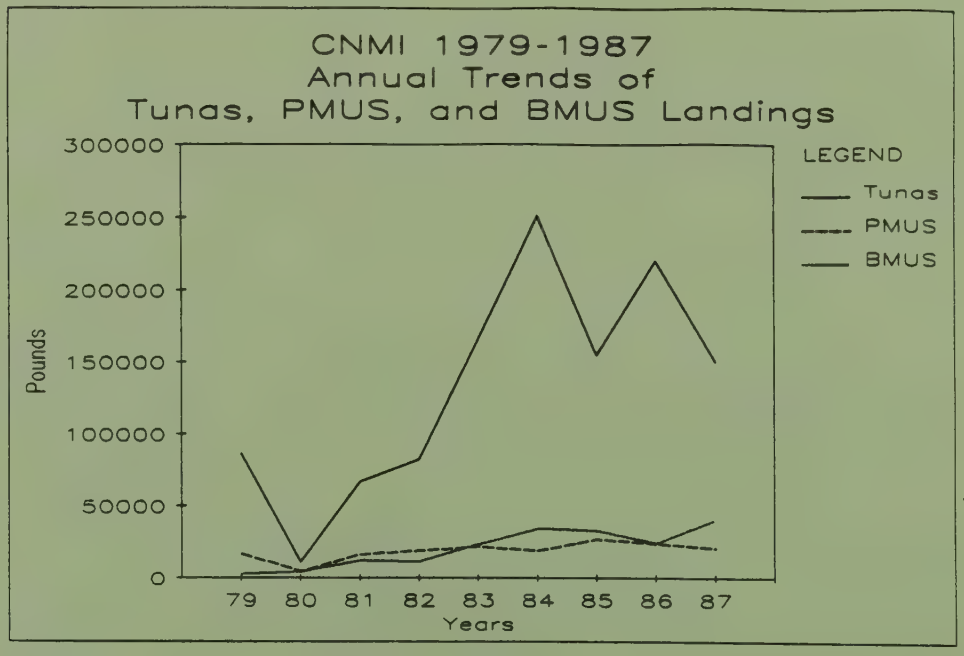


Figure 43. The CNMI total and bottomfish annual commercial landings: 1982-87

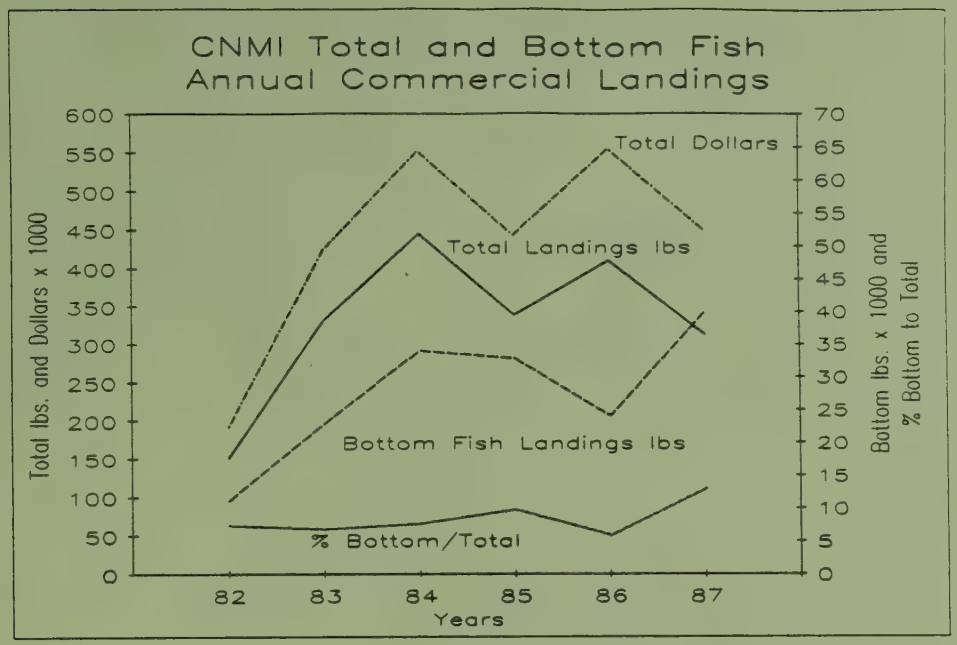


Figure 44. Number of the CNMI fishermen making bottomfish landings: 1982-87

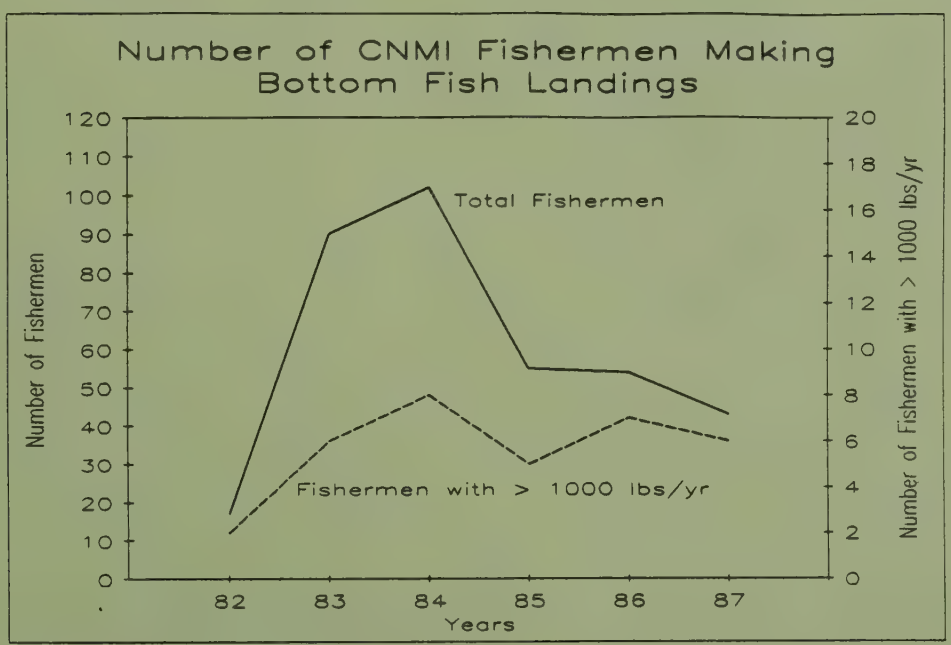


Table 23. The CNMI 1982 commercial landings of bottomfish species.

SPECIES	RECORDS	POUNDS	VALUE	$/LB
Jacks	14	573.50	995.85	1.74
Bottomfish	26	7256.50	11242.63	1.55
Gindai (Flower Snap)	1	10.50	16.27	1.55
Grouper	20	569.00	977.35	1.72
Onaga (Red Snapper)	6	198.50	526.84	2.65
Opakapaka (Pink Snap)	2	86.00	215.00	2.50
Emperor (Mafute)	30	2382.50	4110.01	1.73
** Total Bottomfish **	99	11076.50	18083.95	1.63
** Total All Species **	1058	150762.74	191418.21	1.27

Table 24. CNMI 1982 commercial landings of bottomfish species.

SPECIES	RECORDS	POUNDS	VALUE	$/LB
Jacks	34	825.15	1322.47	1.60
Bottomfish	199	10398.10	18178.89	1.75
Gindai (Flower Snap)	11	213.50	432.35	2.03
Grouper	59	1090.50	1713.03	1.57
Onaga (Red Snapper)	23	894.00	2527.64	2.83
Opakapaka (Pink Snap)	38	1617.90	2917.41	1.80
Emperor (Mafute)	309	7644.10	12910.91	1.69
** Total Bottomfish **	673	22683.25	40002.70	1.76
** Total All Species **	4904	330752.47	423832.71	1.28

Table 25. The CNMI 1984 commercial landings of bottomfish species.

SPECIES	RECORDS	POUNDS	VALUE	$/LB
Jacks	18	724.50	1194.23	1.65
Bottomfish	272	16777.00	29665.84	1.77
Gindai (Flower Snap)	19	638.50	1255.77	1.97
Grouper	47	2512.90	3300.30	1.31
Onaga (Red Snapper)	26	820.80	2075.36	2.53
Opakapaka (Pink Snap)	22	1311.00	2560.00	1.95
Emperor (Mafute)	236	11139.60	18953.45	1.70
** Total Bottomfish **	640	33924.30	59004.95	1.74
** Total All Species **	4976	444558.57	551200.93	1.24

Table 26. The CNMI 1985 commercial landings of bottomfish species.

SPECIES	RECORDS	POUNDS	VALUE	$/LB
Jacks	12	769.84	1066.99	1.39
Bottomfish	180	17522.84	29615.52	1.69
Gindai (Flower Snap)	3	166.25	325.63	1.96
Grouper	22	3368.00	4537.31	1.35
Onaga (Red Snapper)	23	893.75	2424.88	2.71
Opakapaka (Pink Snap)	10	544.95	1190.26	2.18
Uku (Gray Snapper)	3	65.00	162.00	2.49
Amberjack	3	108.25	222.11	2.05
Emperor (Mafute)	92	9341.15	15851.09	1.70
** Total Bottomfish **	348	32780.03	55395.79	1.69
** Total All Species **	3590	338427.73	443229.69	1.31

Table 27. The CNMI 1986 commercial landings of bottomfish species.

SPECIES	RECORDS	POUNDS	VALUE	$/LB
Jacks	14	654.50	1255.73	1.92
Bottomfish	125	11622.09	20529.67	1.77
Gindai (Flower Snap)	15	698.96	1623.15	2.32
Grouper	23	1195.00	2326.75	1.95
Onaga (Red Snapper)	32	1278.27	3852.76	3.01
Opakapaka (Pink Snap)	14	789.80	1632.60	2.07
Uku (Gray Snapper)	3	290.50	859.25	2.96
Emperor (Mafute)	71	7400.05	12998.74	1.76
** Total Bottomfish **	297	23929.17	45078.65	1.88
** Total All Species **	3880	410024.50	554676.40	1.35

Table 28. The CNMI 1987 commercial landings of bottomfish species.

SPECIES	RECORDS	POUNDS	VALUE	$/LB
Jacks	12	485.62	1109.39	2.28
Bottomfish	151	24742.92	43633.83	1.76
Gindai (Flower Snap)	4	217.00	469.50	2.16
Grouper	13	577.00	1055.70	1.83
Onaga (Red Snapper)	12	377.50	1045.07	2.77
Opakapaka (Pink Snap)	19	917.00	2107.21	2.30
Emperor (Mafute)	82	12454.75	22447.21	1.80
** Total Bottomfish **	293	39771.79	71867.91	1.81
** Total All Species **	2706	312608.99	448409.83	1.43

D. Fishing Effort

1. Fleet Dynamics

A total of 43 vessels made bottomfish landings in 1987, a drop from 1986 (Table 22). Since it is sometimes very useful to separately analyze the major contributors, or "high-liners," in a fishery, most of the statistics in Table 22 and the following figures include the following split: those vessels landing more than 1,000 pounds of bottomfish per year and those that did not.

The annual number of fishermen (vessels) making landings of bottomfish reached a maximum of 102 in 1984, declined to just over half that number in 1985, remained the same in 1986, and then further declined in 1987 (Figure 44). However, the number of vessels landing over 1,000 pounds annually has remained fairly constant since 1983. In the five year period from 1983 to 1987 (1982 data are excluded from these analyses but are included in the figures), 206 vessels recorded landings of bottomfish; however, 110 of these landed less than 100 pounds each. Only 24 vessels landed over 1,000 total pounds of bottomfish over the five year period, and only six vessels landed over 5,000 pounds total. Figure 45 shows the relative importance of these six bottomfish highliners, whose trend in catch mirrors the total bottomfish catch (Figure 43). These six highliners were responsible for making 34% of the number of trips and landing over 57% of the total bottomfish landings, and one of these six was singly responsible for about 32% of the catch and 11% of the trips over the five year period. This highliner was the only vessel that made landings over 1,000 pounds per year in all five years summarized. Over 1,000-pound years occurred for one other vessel for four years, one vessel for three years, and only four vessels for tow of the five years. This explains why the total landings were not significantly affected by the drastic reduction in the number of vessels making bottomfish landings during 1985-87.

2. Number of Trips and CPUE

The current trip ticket receipt system does not obtain information on the number of hours fished per trip; therefore, the CPUE for all analyses in this report is based on number of trips. Two assumptions were made in determining the number of trips: All of the catch sold by a fisherman on a particular day was from a single trip, and all of the catch from a single trip was sold on one day. Based on our knowledge of the fishery, these are good assumptions.

The trend in the total number of individual landings of bottomfish species and the total number of bottomfish fishing trips (Figure 46) is very similar to that for the total number of fishermen (Figure 44), reflecting the significant

Figure 45. Relative importance of the major CNMI bottomfish fishermen.

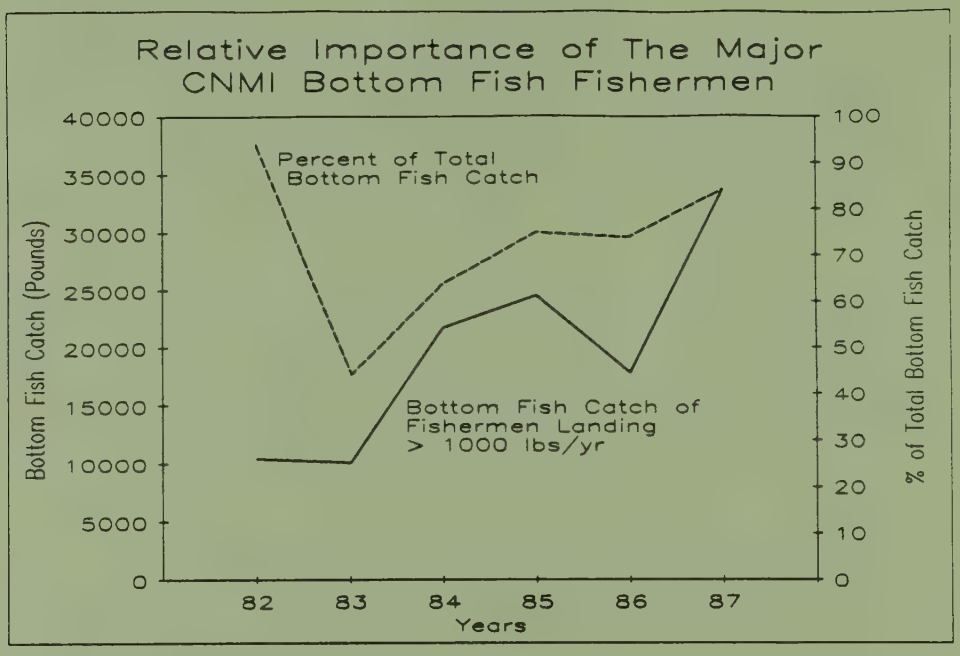
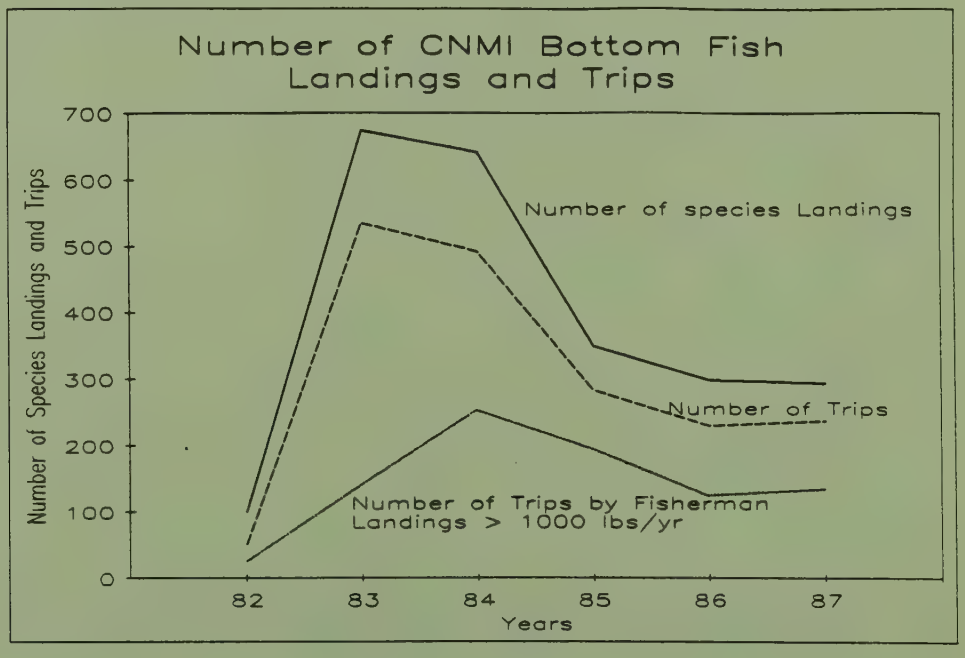


Figure 46. Number of the CNMI bottomfish landings and trips.



declines in 1985 and the somewhat more stable fishery since then. Annual changes in the number of trips taken by fishermen landing over 1,000 pounds of bottomfish per year are proportionately less dramatic than for total fishermen.

Ignoring 1982 because of possible data problems, the bottomfish catch per trip has been increasing steadily since 1983, especially for the highliners. As might be expected, the average catch per trip for the highliners is higher than the average catch of all vessels combined (Figure 47). In fact, if the highliners are separated from the other vessels, their average catch per trip for the five year period is 146 pounds per trip compared to only 55 for all other vessels combined. The highliners typically travel farther and fish longer on each trip than the other vessels. Eventually, attempts will be made to compare catch rates based on catch per hour rather than catch per trip to see whether fishermen actually benefit by traveling farther and fishing longer. Unfortunately, at present, no length of trip data are available.

E. Characteristics of the Catch

1. Geographical and Seasonal Variations

Information is not available at the present regarding specific locations where catches were made within the NMI. However, data on seasonal variations of BMUS, emperorfish and groupers are available (Figure 48). Bottomfish fishing is conducted throughout the year, with slightly more activity in the calmer summer and fall months. The apparent trimodal fluctuations in monthly bottomfish landings are believed to be due to the relatively small magnitude of the fishery and not a characteristic of the resource. However, since this is a seasonality summary based on nine years of data, there may actually be some unknown fishery or resource-based explanation. This remains to be investigated.

2. Species Composition

Tables 23-28 lists annual pounds landed by species 1982-1987. Figure 49 graphs the percent species composition over time (1982-1987) for the four most important species, shows that emperorfish is by far the dominant group, and shows a fairly stable mix with the other species (i.e., grouper, onaga, and opakapaka).

F. Biological Assessment of the Landings

No specific size-frequency data are currently available for bottomfish landed in the CNMI. Additionally, the current trip ticket receipt system does not collect information on the number of pieces landed, so size-frequency data can not be

Figure 47. The CNMI catch per trip for all and major fishermen.

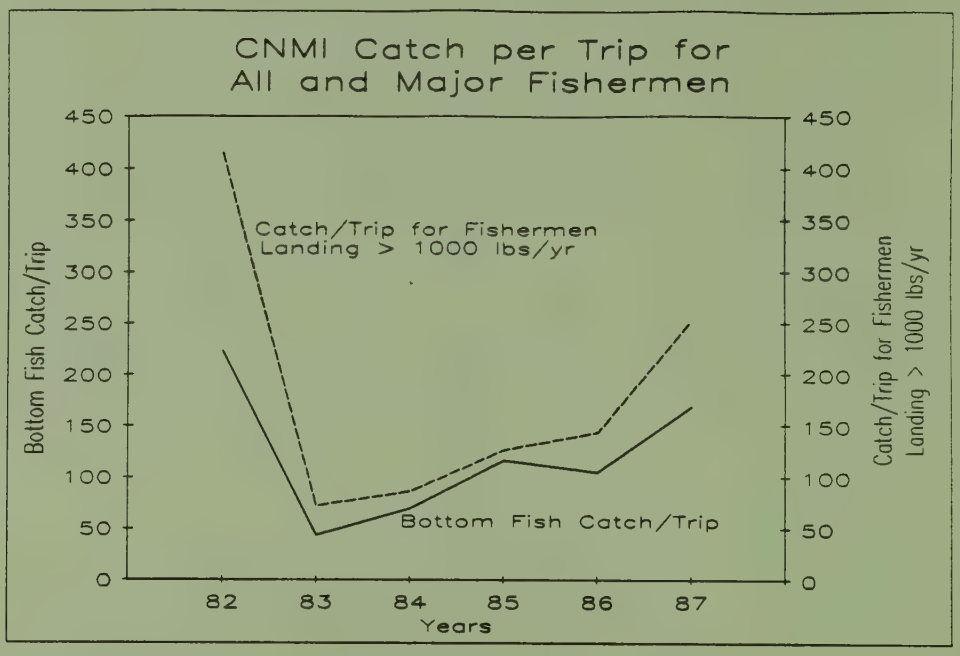


Figure 48. Average monthly landings of BMUS, emperor, and grouper in the CNMI.

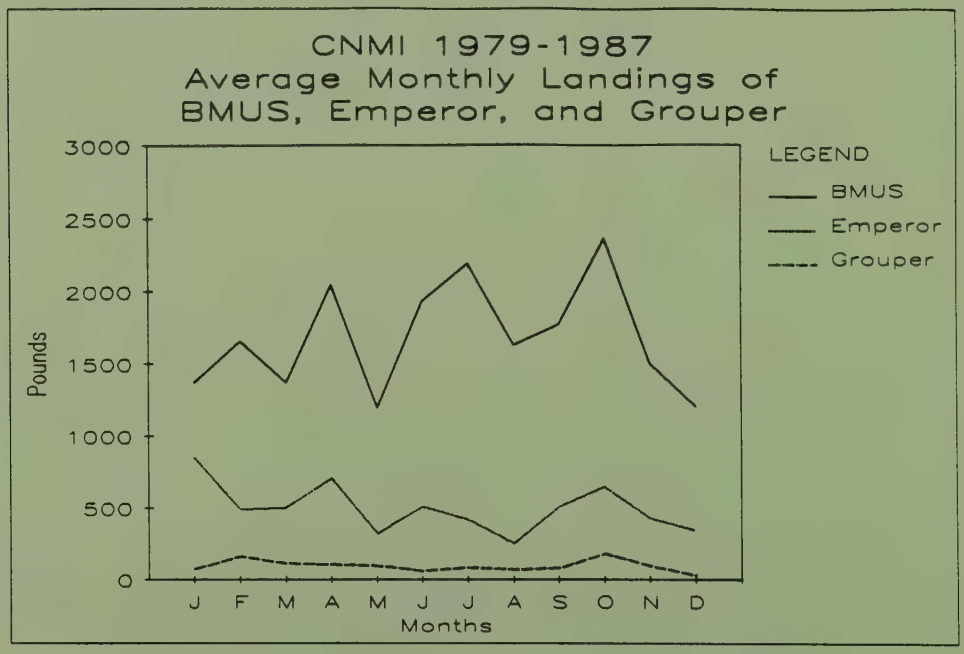
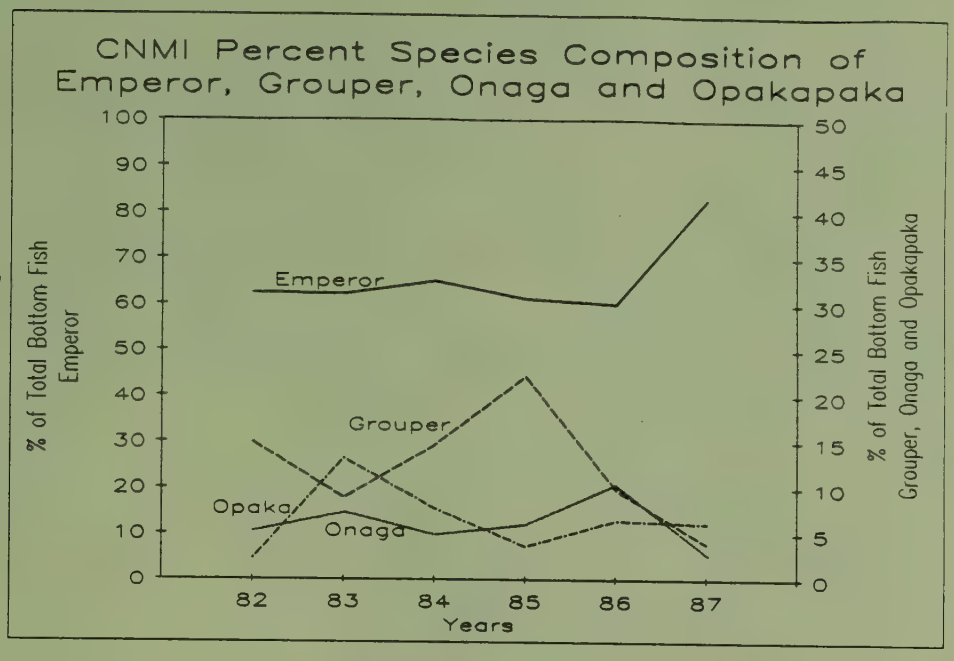


Figure 49. The CNMI percent species composition of emperor, grouper, onaga and opakapaka



generated from it. Assessment of bottomfish stocks based on analyses of size-frequency data is therefore not possible.

1. Maximum Sustainable Yield (MSY)

Between 1982 and 1984, NMFS conducted a Resource Assessment Investigation of the Mariana Archipelago (RAIOMA). Data collected through the RAIOMA program made it possible to estimate sustainable yields for the bottomfish resources of the various islands, banks, and seamounts of Guam and the CNMI. Annual yields were based on productivity estimates associated with the 200-meter contour line around each island or bank. The MSY for the entire archipelago was estimated at 109 MT (metric tons) per year (Polovina, et al., 1985). Excluding areas within the jurisdiction of Guam, the annual sustainable yield of bottomfish from the CNMI is approximately 83.2 MT (183,000 pounds). The 1987 commercial bottomfish landings were the largest on record for the CNMI and amounted to 22% of the areas MSY estimate.

G. Summary Table of Fishery Status

Status of the CNMI Bottomfish Fishery

Problem Condition	Present in the Bottomfish Fishery	Comment
1. Mean catch size is prereproduction	Data unavailable	
2. Unacceptable ratio of fish mortality to natural mortality	Data unavailable	
3. Catch exceeds maximum sustainable yield	No	Polovina et al, 1985
4. Significant decline in CPUE	No	Possibly increasing
5. Substantial decline in ex-vessel revenue relative to baseline levels	No	

Status of the CNMI Bottomfish Fishery (...cont.)

Problem Condition	Present in the Bottomfish Fishery	Comment
6. Significant shift in gear, by area	Data unavailable	
7. Significant change in the frozen/fresh components of catch	Data unavailable	
8. Unstable pattern of entry/exit to the fishery	Possible	Further analysis needed
9. Per trip costs exceed per trip revenues	Not indicated	Study now under way
10. Significant decline or increase in total bottom-fish landings	No	Slight increase
11. Change in species composition of catch	No	Additional research needed
12. Research results indicate problems	No	Additional research needed
13. Habitat degradation or environmental problems	No	
14. Increased interaction with protected species	No	

II. RECENT RESEARCH

The DFW recently reinstituted an offshore creel survey data collection system that should provide additional information on CNMI's bottomfish fishery in the future.

In late 1987, the Council, the University of Guam Marine Laboratory (UGML), DFW, and NMFS began a collaborative project to design, field, and evaluate the result from an economic survey of small-scale commercial bottomfish fishermen in CNMI. The Council contracted UGML to obtain, through the cooperation with DFW, completed questionnaires by personally interviewing fishermen in Saipan. The UGML worked closely with DFW to obtain accurate information on the revenue and costs associated with CNMI bottomfish operations. Similar surveys were conducted in Guam and American Samoa. The NMFS Honolulu Laboratory will computerize the survey data and produce a final report on the economic condition of the bottomfish fishery in each of these areas. The bulk of the work would occur in 1988, therefore, results will be forthcoming in the 1988 annual report.

III. HABITAT CONDITIONS AND RECENT ALTERATIONS

This topic is not addressed at present, but it is felt that the fishery is being controlled currently by environmental, physical and market conditions rather than reduced resource availability.

IV. ENFORCEMENT ACTIVITIES AND PROBLEMS

No enforcement problems were reported by the DFW or NMFS for inclusion in this report.

V. NMFS ADMINISTRATIVE ACTIONS

No administrative actions were reported by NMFS.

VI. TERRITORY MANAGEMENT ACTIONS

No territorial management actions have taken place regarding the bottomfish fishery. Based on the analyses of data presented in this report, no territorial actions are needed at this time.

VII. COUNCIL ACTION

A. Assessment of Need for Council Action

Although analysis of existing data does not identify any problems in the bottomfish fishery of the CNMI, there remain several significant deficiencies in the information base upon which conclusions can be drawn. Additional data are needed, data systems need to be improved, analyses need to be expanded and strengthened, and local expertise needs to be utilized in reporting and analyzing the data.

B. Recommendations for Council Action

The BPMT has made the following three recommendations in regards to the CNMI.

Participation of scientists from the CNMI in Plan Monitoring Team meetings. The problems of the fisheries for bottomfish in Hawaii have received the most attention from the BPMT to date because the problems have been most intense in Hawaii. The BPMT now expects to devote more attention to the bottomfish fishery in the CNMI and wishes to have a scientist from this area named to the BPMT. Participation of a scientist from this area would be particularly helpful in evaluating information on the status of the fishery. The annual review of the fishery is the most important function of the Plan Monitoring Team. It is recommended that a representative from the CNMI be named to the BPMT as soon as possible. The team also recommends that the annual review for both the bottomfish and pelagic species plan be held during the same week should the same scientist be named to the Pelagics Plan Monitoring Team.

Expansion of data gathering programs in the Northern Mariana Islands to include more sites. Although substantial progress has been made in collecting data from the CNMI, greater breadth of coverage should be encouraged. The BPMT recommends expanding the existing data gathering programs designed to intercept commercial landings to include markets on Tinian and Rota. Increased coverage of the market sector would be beneficial to the team's ability to better understand trends in the bottomfish fisheries in the CNMI.

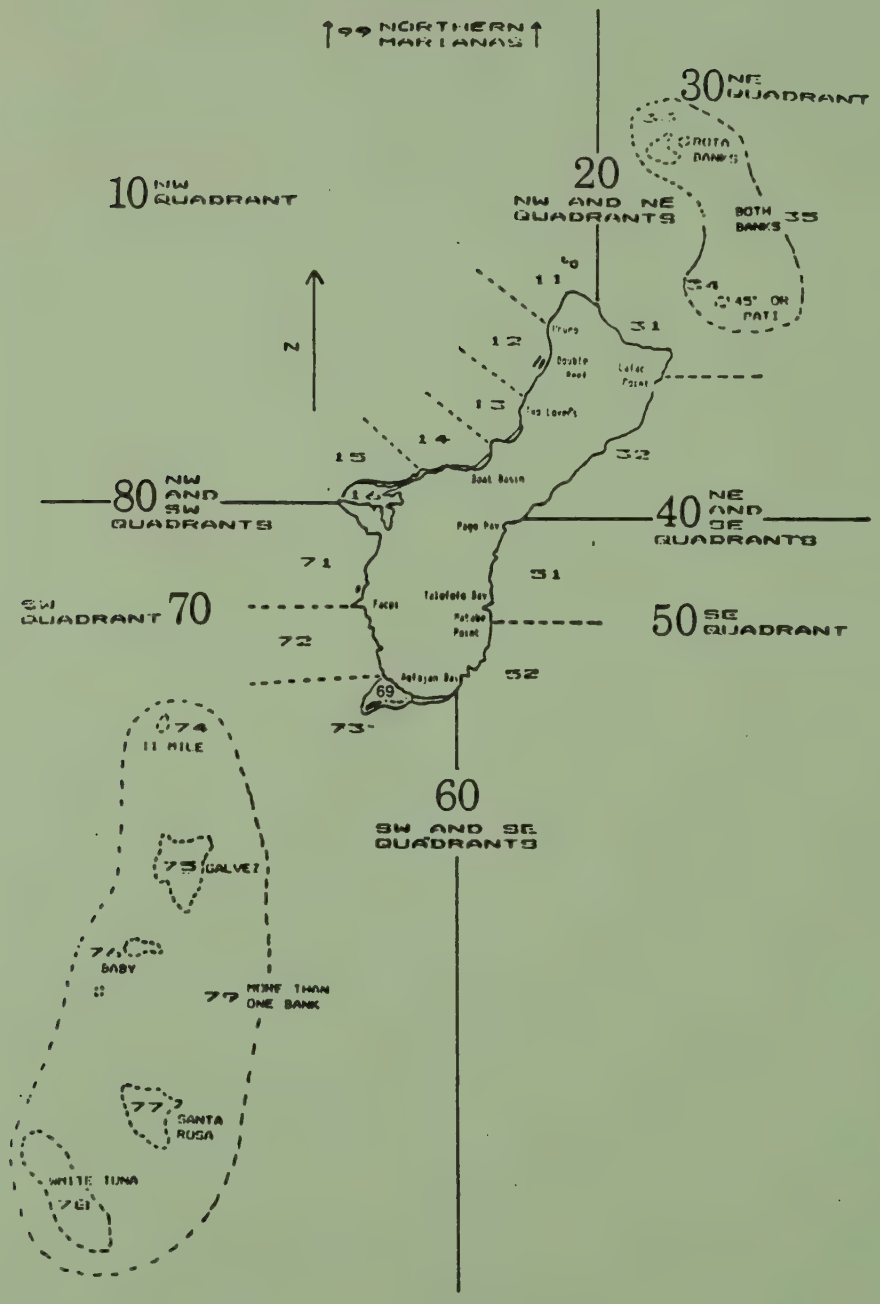
Improved biological statistics for bottomfish stocks in the Northern Mariana Islands. Better species identification and acquisition of extensive size-frequency data is especially important for biological assessment in each of these island areas. Further work to improve fishing effort statistics and information concerning the location of catch are highly desirable and should be encouraged.

C. Estimated Impacts of Recommended Actions

By placing a representative from the CNMI on the BPMT and making this person responsible for the CNMI module of the annual report, a more comprehensive and complete module will be developed, and a better understanding of the CNMI bottomfish fishery will be achieved.

Further analysis of existing data and development of a size-frequency sampling project will provide a more complete understanding and monitoring of the CNMI bottomfish fishery.

Figure 50. Fishing area coding map of Guam



GUAM

Guam is the southernmost island of the chain of Mariana Islands. In addition to fishing areas around the island perimeter, there are several shallow offshore banks (Figure 50) which are popular with Guam fishermen.

Fisheries data from Guam comes from two sources: 1) Data on Guam's commercial fisheries are from invoices voluntarily submitted by wholesalers to WPACFIN. 2) Data from the Guam Division of Aquatic and Wildlife Resource's (DAWR) offshore creel survey data base and expansion files include all handline and pole-and-line bottomfish fishing done from a boat (i.e., both recreational and commercial). The figures, tables and results presented here are from Hamm and Quach (in press); results are preliminary, and subject to change. For a more complete explanation of the data sources or for additional data, see Hamm and Quach (1988).

I. STATUS OF THE FISHERY

A. Overview

Guam 1987 bottomfish landings totaled 10,110 pounds, (4.6% of total commercial landings), and had a value of $18,841.02. A total number of 37 commercial vessels participated in fishing for bottomfish in 1987. Guam does not have an exclusive bottomfish fishery; all commercial bottomfish fishermen are also trollers. Virtually all bottomfish fishing trips include some trolling.

B. Total Landings and Trends

1. Total Pounds Landed

A total of 10,110 pounds of bottomfish were landed in Guam during 1987; landings were essentially the same as 1986, as shown in Figure 51. This figure also shows the growth and large fluctuations of the bottomfish fishery since 1979. The fishery had peak years in 1983 and 1985, followed by sharp declines in landings in 1984 and 1986.

2. Bottomfish Catch Compared to Other Fisheries

Although Guam's commercial bottomfish landings generally comprise less than 5% of the total commercial harvest (Figure 52), the fishery for bottomfish is an important fishery culturally and economically. Bottomfish have a high demand and draw a higher average price than the dominant pelagic fisheries. In 1987, the bottomfish category comprised 4.6% of the total commercial landings. Figure 53 compares the landings of BMUS

Figure 51. Guam total commercial bottomfish landings: 1979-87

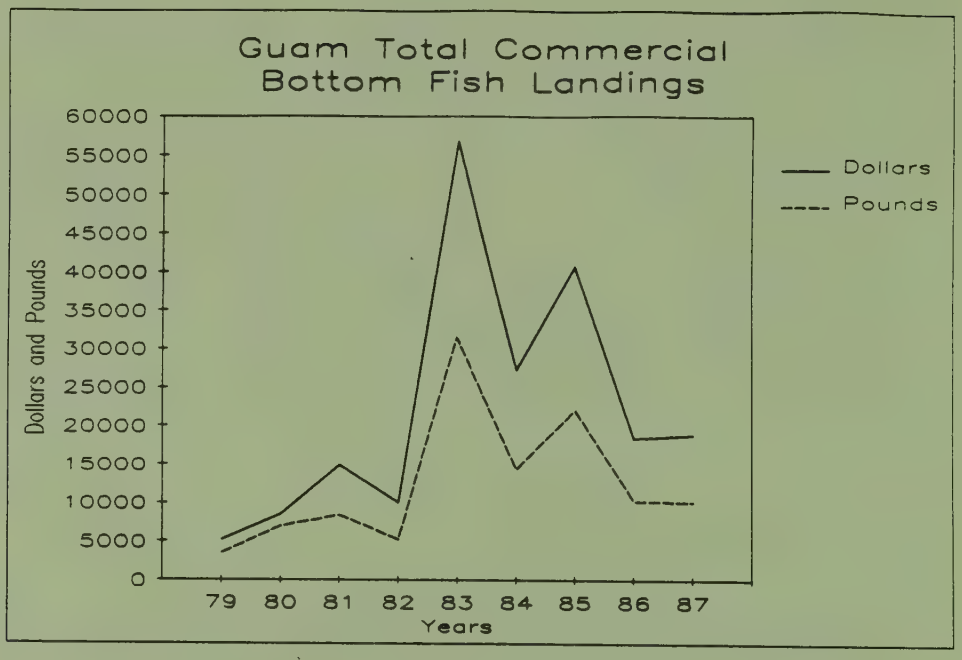


Figure 52. Annual trend of Guam fisheries: 1979-87

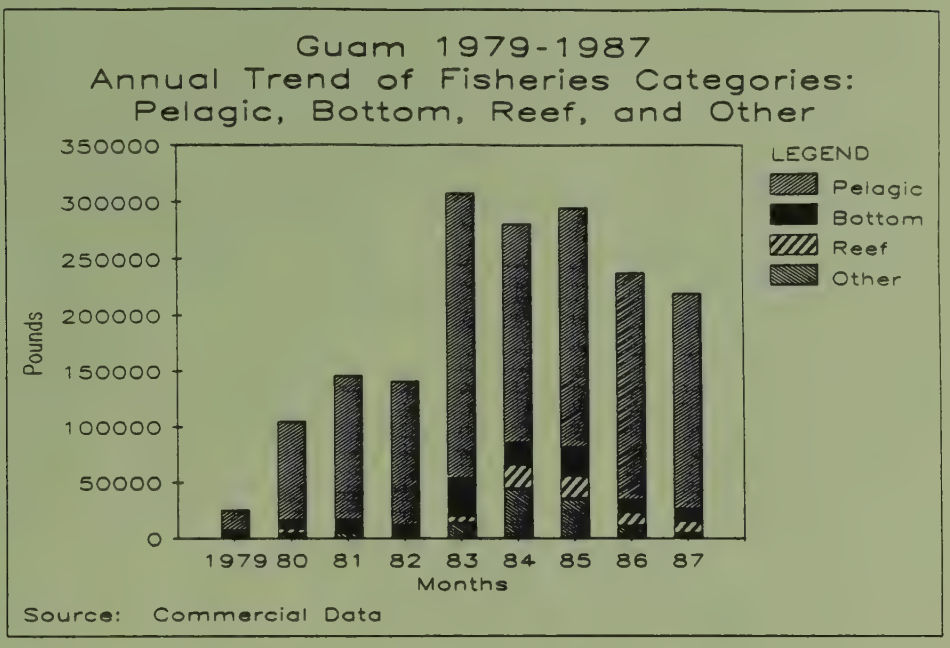
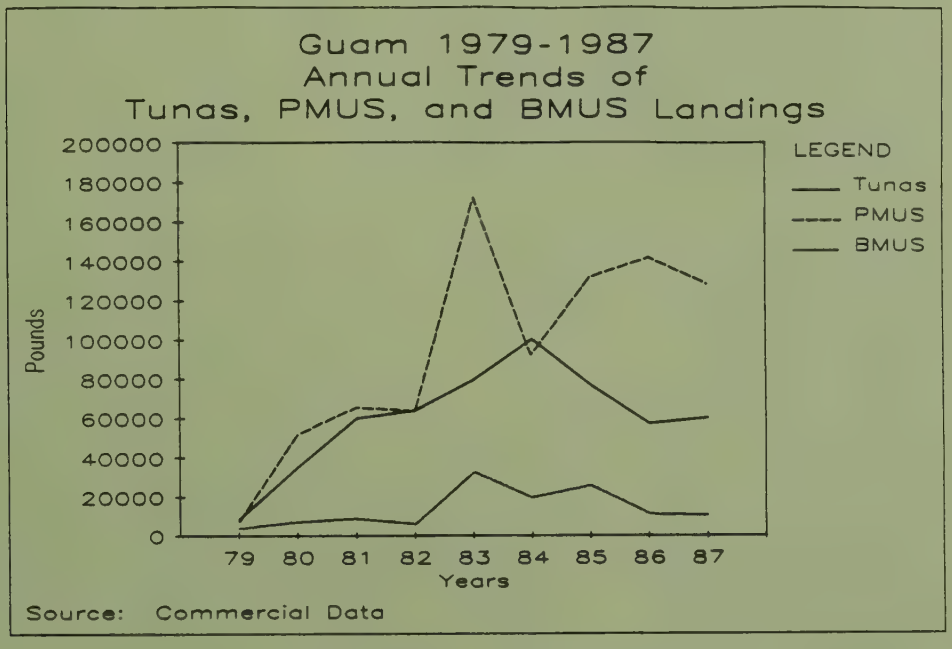


Figure 53. Annual trends of tuna, PMUS, and BMUS landings in Guam: 1979-87



with those of tunas and the PMUS for 1979-87.

C. Revenue and Other Economic Indicators

Total value of the 1987 Guam bottomfish landings was $18,841.02. Table 29 lists the annual value by species and price per pound. Onaga received the highest price per pound, closely followed by ehu, lehi, and opakapaka. Figure 51 shows the historical fluctuations in the value of the fishery and shows that the 1987 value was about the same as in 1986.

D. Fishing Effort

1. Fleet Dynamics

The number of vessels making commercial bottomfish landings during 1983-87 peaked in 1985 (Figure 54). The total number of vessels making commercial landings of bottomfish was essentially the same in 1987 as in 1986, but the number of vessels landing more than 500 pounds for the year doubled, from two in 1986 to four in 1987. Three of these four boats had commercial landings over 1,000 pounds, compared to 1986 when only one boat landed over 1,000 pounds.

2. Number of Trips and CPUE

Table 30 provides estimates of the total catch (pounds), effort (boat hours), and number of trips with their associated coefficients of variation (CV) from the DAWR creel surveys. The CPUE is a measure of catch per boat hour and was calculated from the individual sample observations over the whole year rather than by dividing the estimated annual catch by the estimated annual boat hours. Similar to the commercial landings data, these creel survey data also show a significant peak in 1985, followed by a sharp decline in 1986 and a slight increase in 1987 (Figure 55).

The average trip length, catch per trip, and catch per hour fished are shown in Figures 56 and 57 for the commercial boats and the average boat, respectively. The catch rate (pounds per hour) is generally slightly higher for the average boat than the commercial boat. This is probably because trip time rather than fishing time is usually recorded for the commercial boats, and because commercial boats generally travel farther (e.g., to the banks) and spend more time in transit, as evidenced by the fact that the length of trip by commercial boats is generally over twice that of the average boat. The commercial catch per trip is about twice the catch of the average creel survey trip. The absence of obvious trends in CPUE seems to indicate a relatively stable fishery resource available for exploitation.

Table 29. Guam 1987 annual commercial landings of bottomfish species.

SPECIES	RECORDS	POUNDS	VALUE	$/LB
Jacks	57	1208.50	1727.61	1.43
Bottomfish	152	5900.90	11637.78	1.97
Ehu (Red Snapper)	4	53.50	120.37	2.25
Gindai (Flower Snap)	14	372.00	793.13	2.13
Grouper	6	168.00	273.37	1.63
Kalekale (Pink Snap)	2	14.50	31.38	2.16
Lehi (Silverjaw)	1	29.00	65.25	2.25
Onaga (Red Snapper)	5	93.00	211.63	2.28
Opakapaka (Pink Snap)	7	154.00	346.50	2.25
Uku (Gray Snapper)	55	1186.50	1775.75	1.50
Emperor (Mafute)	13	931.00	1858.25	2.00
** Total Bottomfish **	316	10110.90	18841.02	
** Total All Species **	4519	219507.30	329225.23	

Figure 54. Number of Guam vessels making commercial bottomfish landings: 1983-87

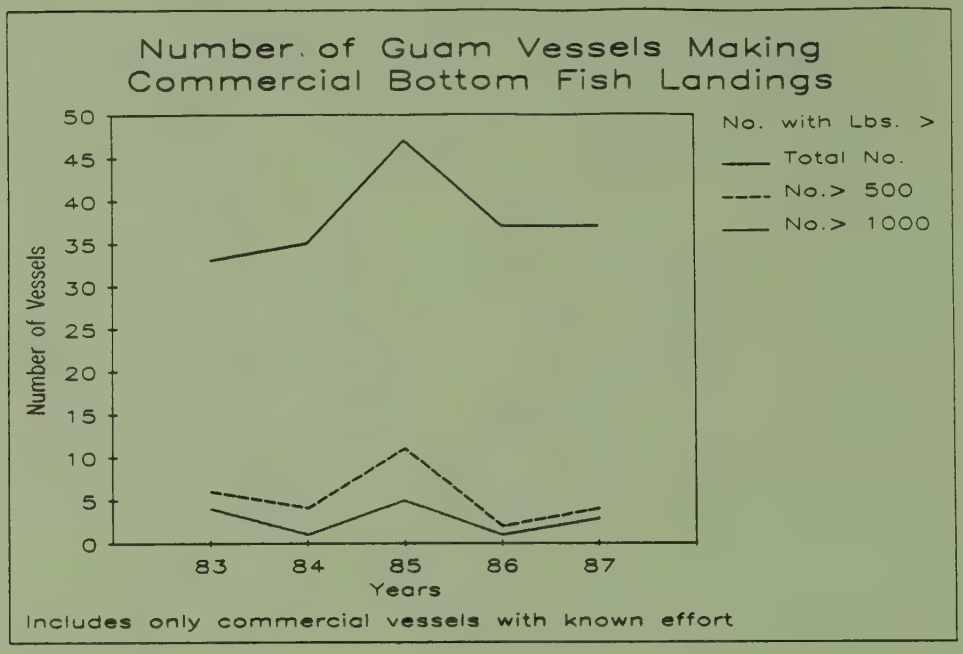


Figure 55. Guam creel survey bottomfish fishing catch and effort estimates: 1979-87

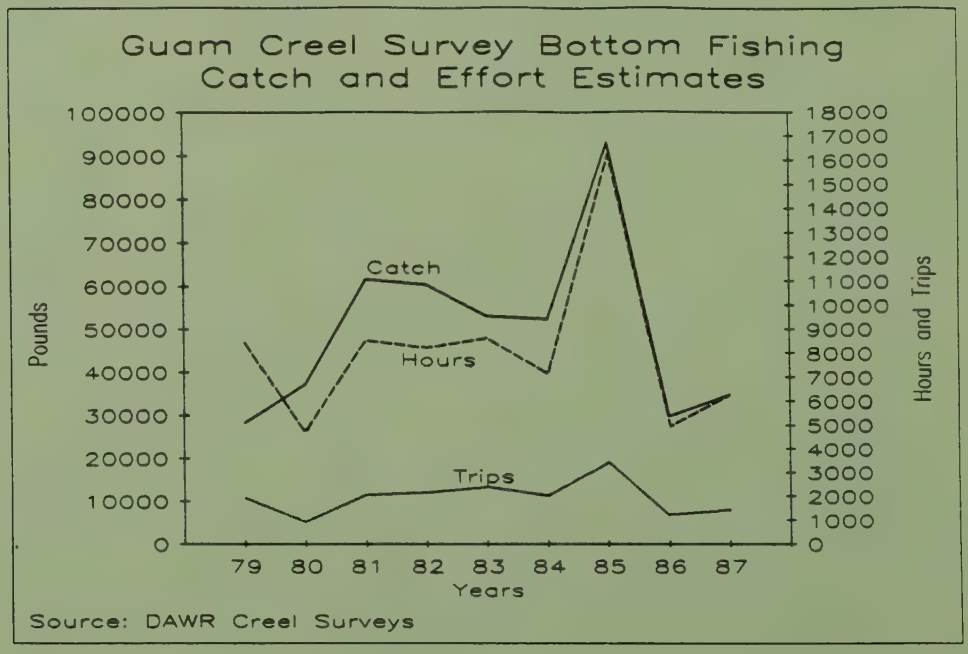


Table 30. Guam creel survey summary statistics.

YEAR	CATCH	CV	BOAT HRS	CV	TRIPS	CV	CPUE	CV
1979	28243	22	8416	20	1918	17	4.3	13
1980	37149	38	4734	29	919	24	6.6	53
1981	61639	27	8523	17	2082	14	6.9	36
1982	60417	21	8215	11	2129	9	7.2	20
1983	53002	25	8620	16	2378	12	5.2	13
1984	52355	14	7141	12	2019	11	6.9	10
1985	92916	13	16242	11	3419	8	5.5	10
1986	29892	34	4945	18	1229	15	5.1	22
1987	34718	22	6210	20	1432	16	5.5	13

Table 31. Percent of total known bottomfish landings by area fished in Guam: 1984-87

AREA	84	85	86	87
Northern Mariana Islands	38	10	10	0
Northeast Banks	7	16	9	16
Southwest Banks	9	17	36	48
Nearshore Island Tips	4	17	14	16
Other Nearshore Reefs	42	40	31	20
EEZ - > 3 miles from shore	54	43	55	64
Guam - < 3 miles from shore	46	57	45	36

Figure 56. Guam commercial bottomfish trip length, catch per trip, and catch per hour fished: 1983-87

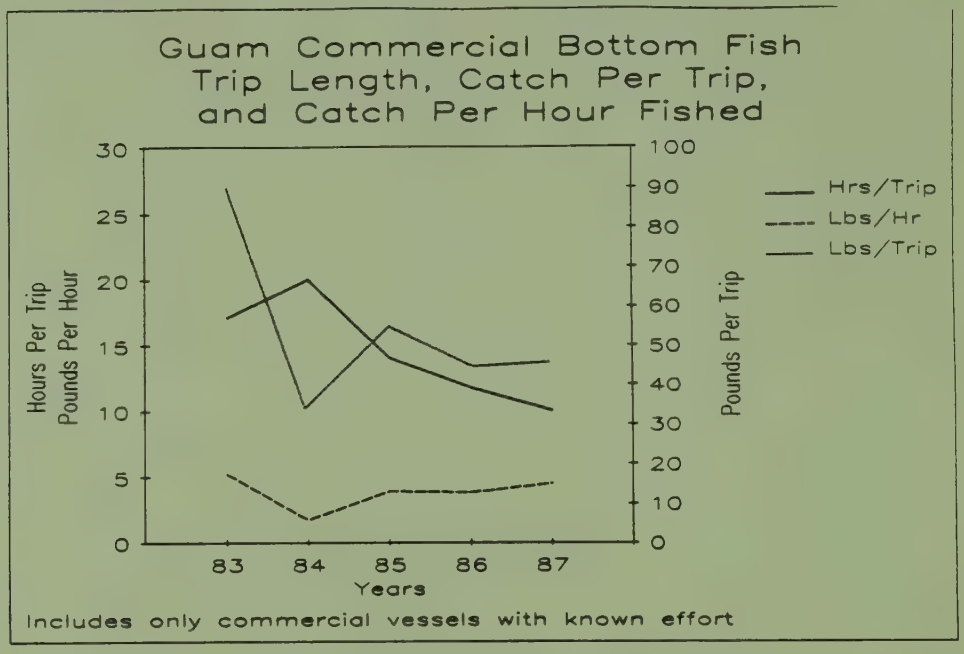
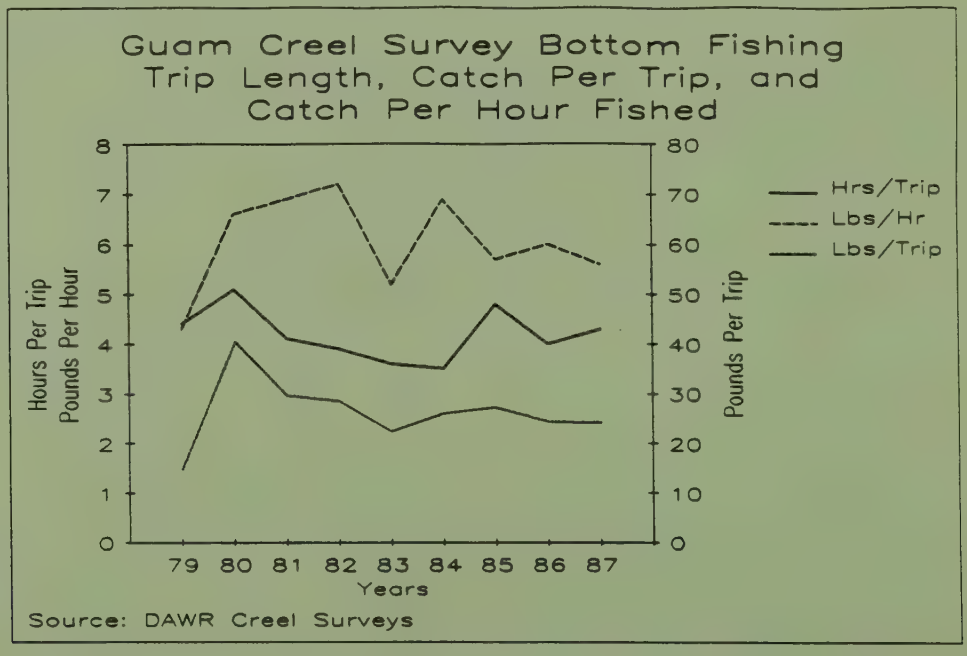


Figure 57. Guam creel survey bottomfishing trip length, catch per hour, and catch per hour fished: 1979-87



E. Characteristics of the Catch

1. Geographical and Seasonal Variations

In regards to the following discussion of area fished, it should be noted that in the commercial data base, there is some question about the accuracy and meaning of "location fished." It may not identify the place of actual capture, but rather the farthest point fished. This needs to be clarified.

In 1984, WPACFIN worked with the participating Guam fish wholesalers and the DAWR to develop and implement a mapping scheme to identify fishing locations (Figure 50). Since that time, the wholesalers have recorded the location of the grounds fished for the majority of trips taken. For analytical purposes, these areas were combined into five major categories: the Northern Mariana Islands (99), the northeast banks (33-35), the southwest banks (74-79), the north and south nearshore island tips (11 and 73), and other nearshore reefs (all other codes). The first three categories represent fishing in the Exclusive Economic Zone (e.g., outside three miles), and the last two, within Guam waters (inside three miles). Table 31 provides a breakdown of the percentages of known landings from these five categories, and Figures 58 and 59 show these data graphically. The trend seems to be toward increased use of EEZ areas, in spite of the fact that fish landings from the Northern Marianas (reported in Guam) declined to zero.

Most landings are made during the calmer summer months, May through August (Figure 60), when the major pelagic fisheries for mahimahi and wahoo are least active. However, even during the peak bottomfish fishing season, landings of pelagic species far outweigh bottomfish landings, and virtually all commercial bottomfish fishing trips are also trolling trips. Guam does not have an exclusive bottomfish fishery.

2. Species Composition

Table 29 lists annual commercial pounds landed per species. The percent composition of commercial bottomfish catch for eight important deep bottomfish species are plotted in Figures 61 and 62. A relative stability seems to exist for gindai, onaga, and opakapaka, whereas groupers appear to be steadily decreasing, uku appear to be increasing, and lehi, kalekale, and ehu all but disappeared in 1987. Changes in species composition typically indicate changes in a fishery, either in the stocks or the fishing activity itself. It is believed that the apparent decrease in groupers is largely due to large catches of groupers from the Northern Mariana Islands in 1983-84. Additionally, most of the variability in the commercial data is thought to be a result of changes in the commercial

Figure 58. Guam bottomfish landings by area percent of known landings: 1984-87

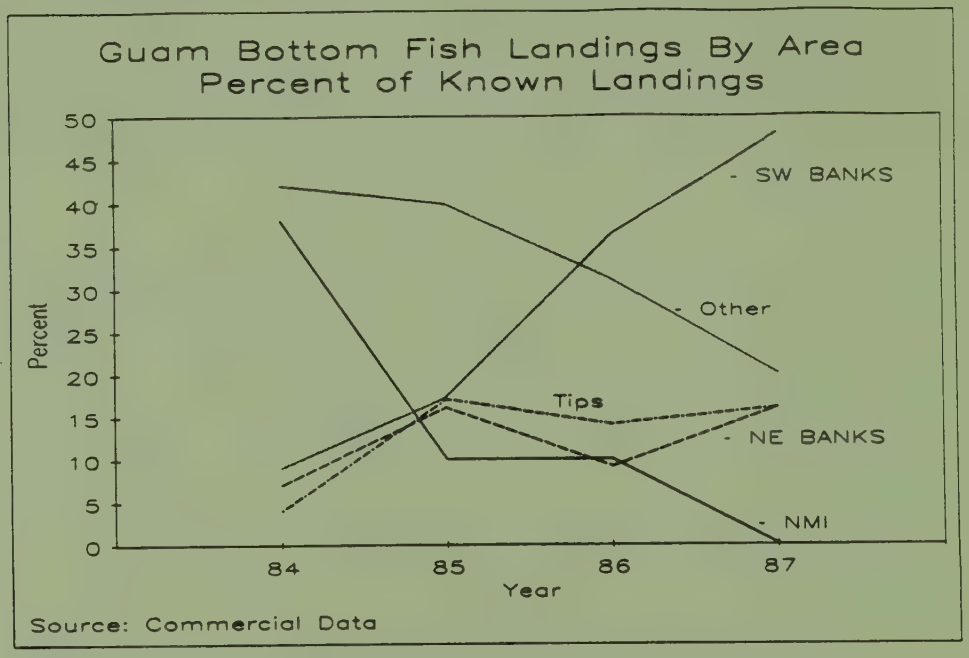


Figure 59. Percent of Guam bottomfish landings by distance from shore: 1984-87

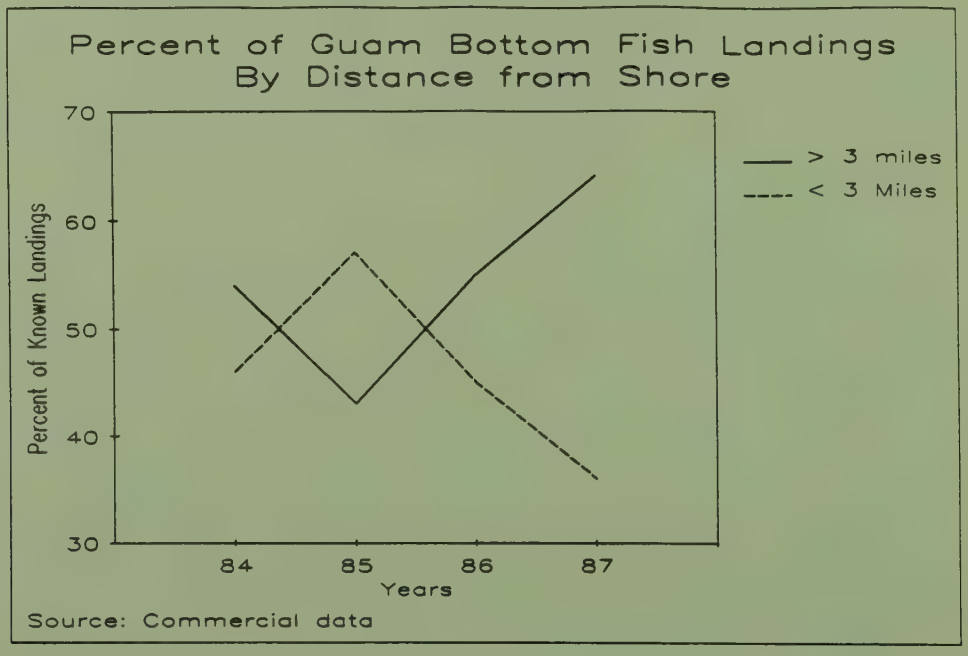


Figure 60. Average monthly landings of BMUS, grouper, and emperor in Guam: 1979-87

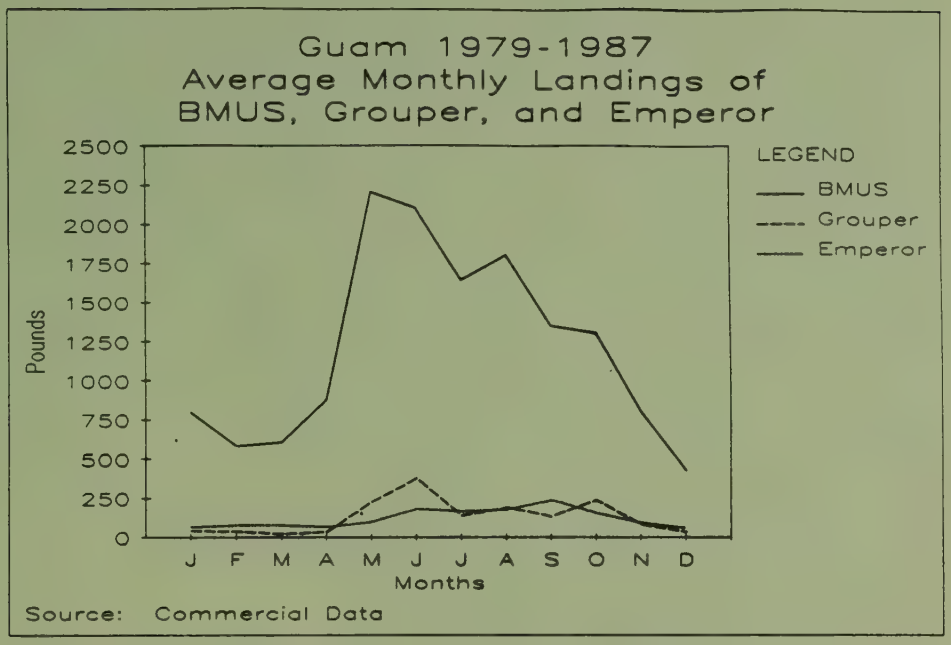


Figure 61. Guam bottomfish species percent composition of grouper, gindai, onaga, and opakapaka: 1980-87

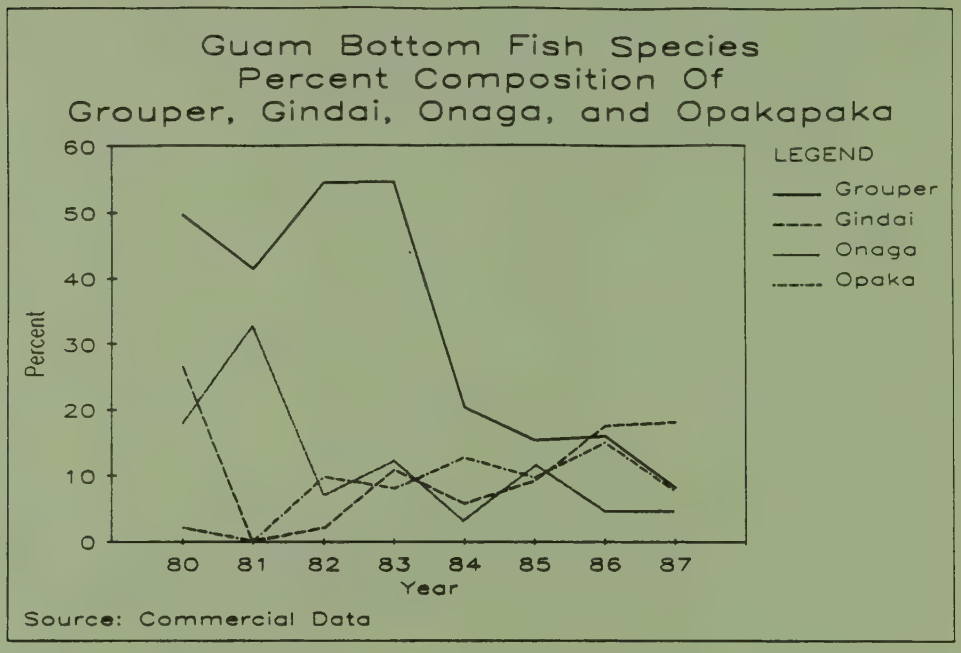
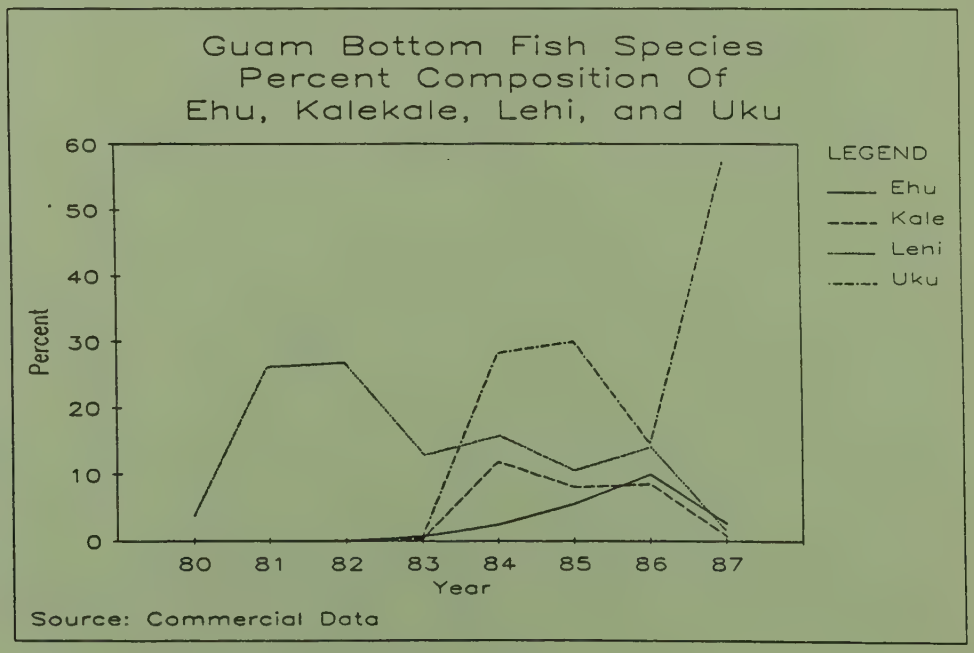


Figure 62. Guam bottomfish species percent composition of ehu, kalekale, lehi, and uku: 1980-87



fishing activity rather than the fish stocks.

The apparent trends in species composition for the commercial data do not seem to hold true for the creel survey data, which show a fluctuating, but stable, species composition for all species. Not all landings inspected by DAWR staff during the creel surveys are identified to the species level; therefore, Table 32 includes three general categories. If it is assumed that the identified portion of the catch is representative of the total catch, the landings combined in these three general categories can be allocated proportionately to the identified species as in Table 33. Figures 63 and 64 show graphs of the share of the catch for the same eight species as listed above.

It was shown in Table 31 that the banks southwest of Guam have been increasing in their importance in the bottomfish fishery. To investigate the stability of the fishery on these banks, the commercial landings records that indicate the location where fishing occurred were analyzed. One area, Baby Bank, has been the most heavily fished and productive southwest bank since 1985 when it first appeared in the data base. The summarized data in Table 34 show increases during 1985-87 in the number of boats, number of trips, and bottomfish landings from Baby Bank. Summaries of catch per trip, average catch per hour, and individual catch per hour for three active fishermen seem to indicate a fairly stable bottomfish population (Table 34). However, remember that in the commercial data base there is some question about the accuracy and meaning of "location fished." Additionally, it should be remembered that essentially all bottomfish fishing trips to Baby Bank include trolling activities, and because the known total bottomfish harvest from Baby Bank is a small percentage of the total catch from this bank (3.5% in 1987), interpretation of bottomfish catch and effort exclusive of pelagics catch and effort may be misleading.

F. Biological Assessment of the Landings

Although some size-frequency data are available from the commercial data and the creel survey data, they are not included here because they are inadequate for meaningful analyses. This shortcoming of both data bases needs to be addressed and resolved.

1. Maximum Sustainable Yield (MSY)

Between 1982 and 1984, NMFS conducted a Resource Assessment Investigation of the Mariana Archipelago (RAIOMA). Data collected through the RAIOMA program made it possible to estimate sustainable yields for the bottomfish resources of the various islands, banks, and seamounts of Guam and the CNMI. Annual yields were based on productivity estimates associated with the 200-meter contour line around each island or bank. The

Table 32. Guam creel survey species composition of selected bottomfish (unallocated miscellaneous bottomfish): 1979-87

SPECIES %	1979	1980	1981	1982	1983	1984	1985	1986	1987
Grouper	2011	627	6442	9441	3971	1519	7736	1226	4087
	7.58%	2.40%	11.79%	17.95%	8.75%	3.02%	9.25%	4.67%	13.09%
Jacks	3102	2591	3887	2255	2918	1747	5028	5852	2501
	11.70%	9.90%	7.11%	4.29%	6.43%	3.47%	6.01%	22.28%	8.01%
Snapper	4110	615	2028	3716	2125	765	2976	1911	1097
	15.50%	2.35%	3.71%	7.06%	4.68%	1.52%	3.56%	7.27%	3.51%
Lehi	455	347	2444	2708	2726	322	1161	609	514
	1.72%	1.33%	4.47%	5.15%	6.01%	0.64%	1.39%	2.32%	1.65%
Uku	292	1363	1557	4964	1330	841	3149	1348	1052
	1.10%	5.21%	2.85%	9.44%	2.93%	1.67%	3.77%	5.13%	3.37%
Ehu	2334	828	4845	1283	1147	32	1506	694	434
	8.80%	3.16%	8.86%	2.44%	2.53%	0.06%	1.80%	2.64%	1.39%
Onaga	1167	0	4095	1087	3809	220	2904	310	466
	4.40%	0.00%	7.49%	2.07%	8.39%	0.44%	3.47%	1.18%	1.49%
Taape	73	80	486	479	172	60	1022	199	1438
	0.28%	0.31%	0.89%	0.91%	0.38%	0.12%	1.22%	0.76%	4.61%
Y.T. Kalekale	300	793	2768	1602	5783	1110	3211	1179	555
	1.13%	3.03%	5.06%	3.05%	12.74%	2.21%	3.84%	4.49%	1.78%
Opakapaka	115	1491	698	744	1221	117	1219	704	340
	0.43%	5.70%	1.28%	1.41%	2.69%	0.23%	1.46%	2.68%	1.09%
Y.E. Opaka	898	389	2353	1723	4342	484	1677	1394	435
	3.39%	1.49%	4.31%	3.28%	9.57%	0.96%	2.01%	5.31%	1.39%
Kalekale	247	0	17	307	764	0	183	23	0
	0.93%	0.00%	0.03%	0.58%	1.68%	0.00%	0.22%	0.09%	0.00%
Gindai	1085	197	1558	1896	1632	291	2521	842	650
	4.09%	0.75%	2.85%	3.60%	3.60%	0.58%	3.02%	3.21%	2.08%
Emperor	7573	10184	11321	17146	11281	10124	28305	4273	11966
	28.56%	38.91%	20.71%	32.59%	24.86%	20.13%	33.85%	16.27%	38.33%
Shallow Bottomfish	0	0	0	0	0	0	6159	1114	899
	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	7.37%	4.24%	2.88%
Mixed Bottomfish	2755	6668	10155	3254	2154	32651	13168	3323	3166
	10.39%	25.48%	18.58%	6.19%	4.75%	64.93%	15.75%	12.65%	10.14%
Deep Bottomfish	0	0	0	0	0	0	1687	1268	1615
	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.02%	4.83%	5.17%
TOTAL SELECTED SPECIES:	26517	26173	54654	52605	45375	50283	83612	26269	31215
TOTAL ALL BOTTOM FISH SPECIES:	28245	37149	61639	60417	53002	52355	92916	29893	34718

Table 33. Guam creel survey species composition of selected bottomfish (allocated miscellaneous bottomfish): 1979-87

SPECIES %	1979	1980	1981	1982	1983	1984	1985	1986	1987
Grouper	2230	778	7746	9983	4140	4221	9658	1603	5376
	8.46%	3.21%	14.48%	19.13%	9.19%	8.62%	11.87%	6.27%	17.56%
Jacks	3440	3215	4674	2384	3042	4854	6678	7072	2878
	13.05%	13.28%	8.74%	4.57%	6.75%	9.91%	8.21%	27.69%	9.40%
Snapper	4557	763	2438	3929	2216	2126	3953	2309	1262
	17.30%	3.15%	4.56%	7.53%	4.92%	4.34%	4.86%	9.04%	4.12%
Lehi	505	431	2939	2863	2842	895	1449	796	676
	1.91%	1.78%	5.49%	5.49%	6.31%	1.83%	1.78%	3.12%	2.21%
Uku	324	1691	1872	5249	1387	2337	4182	1629	1211
	1.23%	6.99%	3.50%	10.06%	3.08%	4.77%	5.14%	6.38%	3.95%
Ehu	2588	1027	5825	1357	1196	89	1880	907	571
	9.82%	4.25%	10.89%	2.60%	2.65%	0.18%	2.31%	3.55%	1.86%
Onaga	1294	0	4924	1149	3972	611	3625	405	613
	4.91%	0.00%	9.20%	2.20%	8.81%	1.25%	4.46%	1.59%	2.00%
Taape	81	99	584	506	179	167	1357	240	1655
	0.31%	0.41%	1.09%	0.97%	0.40%	0.34%	1.67%	0.94%	5.41%
Y.T. Kalekale	333	984	3328	1694	6030	3084	4009	1541	730
	1.26%	4.07%	6.22%	3.25%	13.38%	6.30%	4.93%	6.03%	2.38%
Opakapaka	128	1850	839	787	1273	325	1522	920	447
	0.48%	7.64%	1.57%	1.51%	2.83%	0.66%	1.87%	3.60%	1.46%
Y.E. Opaka	996	483	2829	1822	4527	1345	2094	1822	572
	3.78%	1.99%	5.29%	3.49%	10.05%	2.75%	2.57%	7.13%	1.87%
Kalekale	274	0	20	325	797	0	228	30	0
	1.04%	0.00%	0.04%	0.62%	1.77%	0.00%	0.28%	0.12%	0.00%
Gindai	1203	244	1873	2005	1702	809	3147	1101	855
	4.57%	1.01%	3.50%	3.84%	3.78%	1.65%	3.87%	4.31%	2.79%
Emperor	8397	12637	13612	18130	11762	28130	37593	5164	13770
	31.87%	52.21%	25.44%	34.74%	26.10%	57.42%	46.20%	20.22%	44.98%
TOTAL SELECTED SPECIES>	26348	24203	53503	52184	45065	48991	81376	25541	30616

Figure 63. Guam bottomfish species percent composition of grouper, gindai, onaga, and opakapaka: 1979-87

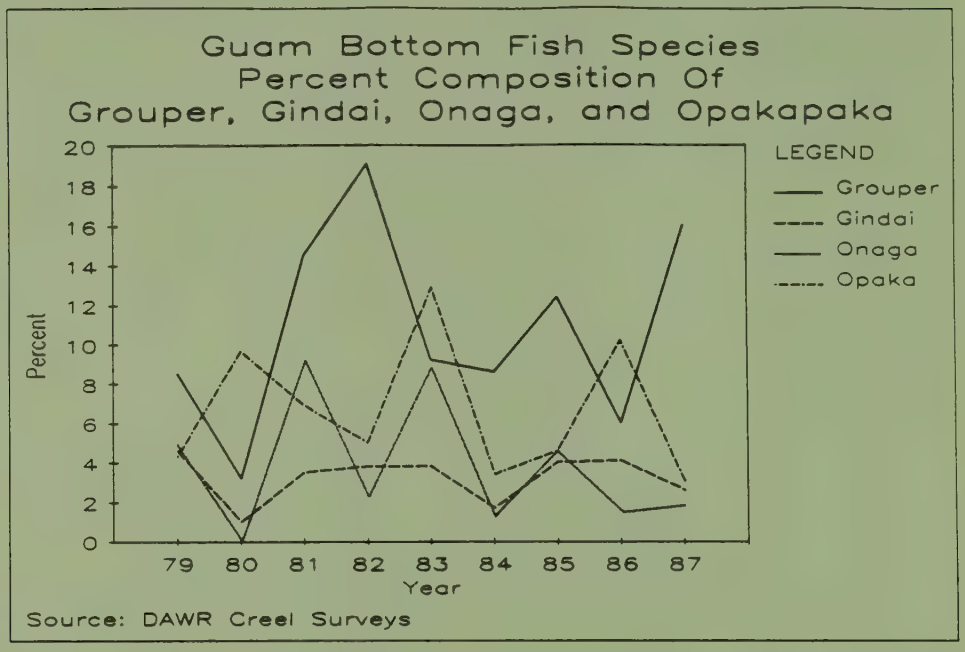


Figure 64. Guam bottomfish species percent composition of ehu, kalekale, lehi, and uku: 1979-87

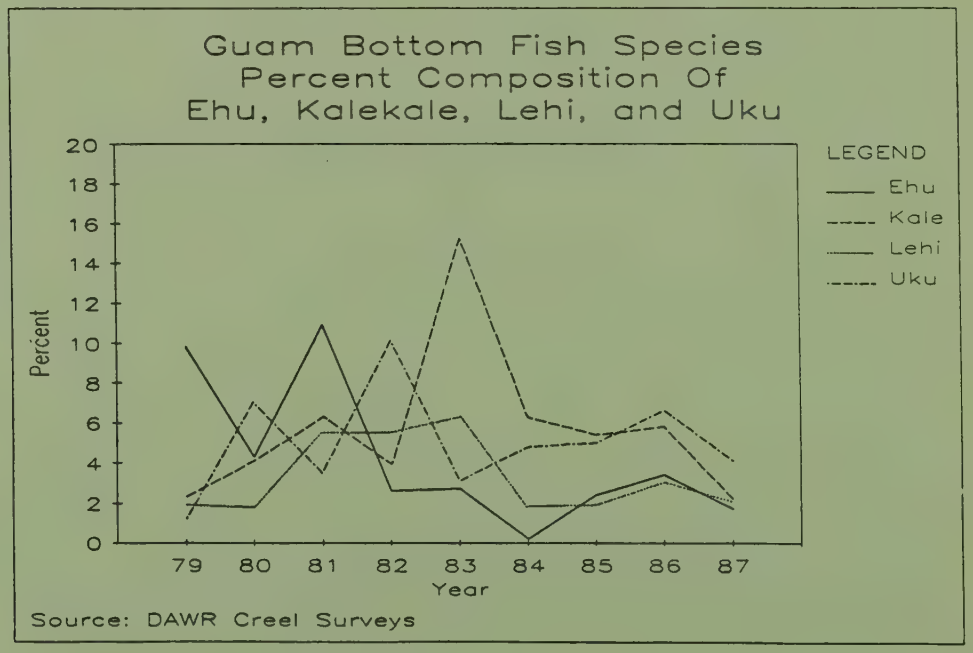


Table 34. Guam's Baby Bank summary information

	1985	1986	1987
Number of Boats	12	13	16
Number of Trips	24	27	30
Bottomfish Landings	1325	1613	1814
Hours Fished	305	432	355
Catch Per Trip	55	60	60
Catch Per Hour	4.3	3.7	5.1
Catch Per Hour Fisher 1	8.6	2.0	4.0
Catch Per Hour Fisher 2	7.9	1.7	5.3
Catch Per Hour Fisher 3	5.7	5.3	-

MSY for the entire archipelago was estimated at 109 MT (metric tons) per year (Polovina, et al., 1985). Excluding areas within the jurisdiction of the CNMI, the annual sustainable yield of bottomfish from Guam (including Galvez and Santa Rosa Island) is approximately 25.8 MT (56,800 pounds). The recorded bottomfish landings from Guam in 1986 and 1987 were approximately 46%, and 55% respectively, of the area's annual MSY estimate and were relatively low when compared to previous year, (Figure 55 and Table 32).

G. Summary Table of Fishery Status

Status of the Guam Bottomfish Fishery

Problem Condition	Present in the Bottomfish Fishery	Comment
1. Mean catch size is prereproduction	Not indicated	More analyses needed
2. Unacceptable ratio of fish mortality to natural mortality	Data unavailable	
3. Catch exceeds maximum sustainable yield	No	Polovina et al, 1985
4. Significant decline in CPUE	Not indicated	More analyses are needed
5. Substantial decline in ex-vessel revenue relative to baseline levels	Data unavailable	
6. Significant shift in gear, by area	Potential	Trend toward SW banks
7. Significant change in the frozen/fresh components of catch	Not indicated	

Status of the Guam Bottomfish Fishery (...cont.)

Problem Condition	Present in the Bottomfish Fishery	Comment
8. Unstable pattern of entry/exit to the fishery	Yes	
9. Per trip costs exceed per trip revenues	Not indicated	Study now under way
10. Significant decline or increase in total bottom-fish landings	Yes	General increase, but sporadic
11. Change in species composition of catch	Not indicated	More analyses needed
12. Research results indicate pro-blems	No	More analyses needed
13. Habitat degradation or environ-mental problems	Data unavailable	
14. Increased interaction with protected species	Data unavailable	

II. RECENT RESEARCH

Results of DAWR's offshore creel surveys are presented, in part, in the previous section. For additional information on these surveys, refer to Hamm et al. (1986) and Hamm and Quach (1988). The DAWR recently began more in-depth analyses of their existing creel survey data, and have entered into an arrangement with Dr. Steve Amesbury at the University of Guam to conduct other analyses.

In late 1987, the Council, the University of Guam Marine Laboratory (UGML), DFW, and NMFS began a collaborative project to design, field, and evaluate the result from an economic survey of small-scale commercial bottomfish fishermen in Guam. The Council contracted UGML to obtain completed questionnaires by personally interviewing fishermen. The project was developed to estimate the revenue and costs associated with Guam bottomfish fishing operations. Similar surveys were conducted in CNMI and American Samoa. The NMFS Honolulu Laboratory will computerize the survey data and produce a final report on the economic condition of the bottomfish fishery from each of these areas. The bulk of the work would occur in 1988, therefore, results will be forthcoming in the 1988 annual report.

III. HABITAT CONDITIONS AND RECENT ALTERATIONS

No information regarding this topic is available at present.

IV. ENFORCEMENT ACTIVITIES AND PROBLEMS

No information regarding enforcement aspects of Guam's bottomfish fishery is available at present.

V. NMFS ADMINISTRATIVE ACTIONS

No administrative actions were identified by NMFS.

VI. STATE/TERRITORY MANAGEMENT ACTIONS

No territorial management actions have taken place regarding the bottomfish fishery, and based on the analyses of data presented in this report, none are needed at this time.

VII. COUNCIL ACTION

A. Assessment of Need for Council Action

Assessment for needs for Council action are summarized below in the recommendations for action.

B. Recommendations for Council Action

The BPMT has made the following three recommendations in regards to bottomfish fishing in Guam; they are as follows:

Participation of scientists from Guam in Plan Monitoring Team meetings. The problems of the fisheries for bottomfish in Hawaii have received the most attention from the BPMT to date because the problems have been most intense in Hawaii. The BPMT now expects to devote more attention to the bottomfish fishery in Guam and wishes to have a scientist from this area named to the BPMT. Participation of scientists from these areas would be particularly helpful in evaluating information on the status of the fishery. The annual review of the fishery is the most important function of the Plan Monitoring Team. It is recommended that a representative from Guam be named to the PMT as soon as possible. The team also recommends that the annual review for both the bottomfish and pelagic species plan be held during the same week should the same scientist be named to the Pelagics Plan Monitoring Team.

Expansion of data gathering programs in Guam to include more sites. Although substantial progress has been made in collecting data from Guam, greater breadth of coverage should be encouraged. The BPMT recommends expanding the existing data gathering programs designed to intercept commercial landings to include more of the small wholesale/retail outlets (e.g., hotels) in Guam. Increased coverage of these market sectors would be beneficial to the team's ability to better understand trends in the bottomfish fishery in Guam.

Improved biological statistics for bottomfish stocks in Guam. Better species identification and acquisition of extensive size-frequency data is especially important for biological assessment in Guam. Further work to improve fishing effort statistics and information concerning the location of catch are highly desirable and should be encouraged.

C. Estimated Impacts of Recommended Action

By placing a DAWR staff person on the Bottomfish Plan Monitoring Team and making this person responsible for the Guam module, a more comprehensive and complete module will be developed, and a better understanding of the Guam bottomfish fishery will be achieved.

Further analysis of existing data and development of a size-frequency sampling project will provide a more complete understanding and monitoring of the Guam bottomfish fishery.

PACIFIC ISLAND POSSESSIONS

Wake Island, Johnston Atoll, Kingman Reef, Palmyra Island, Jarvis Island, and Howland and Baker Islands are all within the jurisdiction of the Western Pacific Regional Fishery Management Council (Figure 1). There are at present no commercial bottomfish fisheries associated with these areas.

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APPENDIX A

GENERAL BACKGROUND ON THE WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

The Council was created by the Magnuson Fishery Conservation and Management Act (MFCMA) of 1976, the law which established exclusive U.S. jurisdiction over all fish (except highly migratory species) in Federal waters of the Exclusive Economic Zone (EEZ). The EEZ consists of the waters extending to a distance of 200 nautical miles from the baseline for measuring the territorial sea. The Council governs the EEZ around the islands of American Samoa, Guam, Hawaii, the Commonwealth of Northern Mariana Islands, and U.S. possessions in the Pacific.

The main task of the Council is to manage the fisheries within the EEZ -- to prevent overfishing while encouraging economic development. To accomplish this, the Council identifies fish species and species groups in need of management, analyses of the biological, economic, social and environmental factors affecting each of the species to be managed and prepares regulations to insure that only the "optimum yield" of each fishery is taken by commercial and recreational fishermen. The Council prepares Fishery Management Plans (FMPs) and reviews applications by foreign governments for the right to fish in waters of American flag islands in the Pacific. The FMP's and fishing regulations are jointly enforced by the National Marine Fisheries Service and the U.S. Coast Guard.

A Fishery Management Plan for lobster has been implemented, and the lobster fishery in the Northwestern Hawaiian Islands (NWHI) is subject to fishing regulations. The Council adopted State regulatory measures for spiny lobster fishing in the FCZ around the Main Hawaiian Islands. FMP's have been approved for precious corals and the snapper-grouper-jack complex of bottomfish. A limited entry program was recently approved for the NWHI bottomfish fishery and will be implemented on January 1, 1989. Also within the bottomfish FMP a six year moratorium is in place for seamount groundfish. The Council also has an FMP in place for billfish and other pelagic species. The need for management of other resources, including shrimp and coastal pelagic species (e.s., akule, opelu), is being assessed. Highly migratory species, such as tuna, are excluded from jurisdiction under the MFCMA, and, therefore, are not regulated by the Council.

The Council consists of 14 members drawn from the fishing community and governmental bodies of the three island areas. Half of the Council members are appointed by the U.S. Secretary of Commerce from lists submitted by the island Governors. The other members of the Council are designated because their local government positions give them fisheries responsibilities. The

meeting of the Council (and its scientific, planning and industry advisory committees) are open to the public. Meetings generally alternate amongst the island areas to encourage public interest and participation.

In addition to its statutory functions, the Council takes a strong interest in promoting fisheries development and in encouraging cooperative management and development efforts with island governments throughout the Pacific.

The approximate areas of fishery management for the Western Pacific Region are given below. (Based on a chart compiled by Charles E. Harrington, National Ocean Survey.)

UNITED STATES EXCLUSIVE FISHERIES
JURISDICTION IN WESTERN PACIFIC REGION

HAWAIIAN ARCHIPELAGO	695,000
GUAM	58,000
AMERICAN SAMOA	117,500
NORTHERN MARIANA ISLANDS	123,800
HOWLAND AND BAKER ISLANDS	124,100
WAKE ISLAND	120,000
PALMYRA-KINGMAN REEF	104,100
JARVIS ISLAND	94,200
JOHNSTON ATOLL	131,000
Total sq. nautical miles:	1,567,700

APPENDIX B

THE HDAR C-3 FORM USED BY
COMMERCIAL FISHERMEN TO REPORT FISHCATCH DATA

DEPARTMENT OF LAND AND NATURAL RESOURCES

FISH CATCH REPORT

DIVISION OF AQUATIC RESOURCES
STATE OF HAWAII

1. Name of Licensee: JOHN DOE 2. Commercial Marine License No.: 85-0000

3. Name of Boat: PRINCESS ANN 4. HA No.: HA-0000-CF 5. Federal No.:

6. Month Fished: JANUARY 7. Year Fished — 19 85

☐ Place an "X" in the box if you did not fish

8. Day Fished	9 Area Fished	9a. Buoy Fished	10. Type of Fishing Gear Used	11. Species Caught	12. No. Caught	13. Lbs. Caught	14. Lbs. Sold	15. Value of Lbs Sold	16. Port of Landing
1	331		HANDLINE	OPAKAPAKA	7	51	51	171 40	KEWALO
				EHU	4	13	13	36 27	
				ONAGA	12	101	101	370 00	
4	429		HANDLINE	OPAKAPAKA	6	49	49	159 00	KEWALO
				KALEKALE	2	6	6	12 84	
	409			TAAPE	21	15	15	15 00	
5	422		HANDLINE	EHU	15	41	41	115 00	WAIANAE
				ONAGA	9	79	79	276 50	
				HAPUUPUU	5	12	12	21 00	
10	422		HANDLINE	NONE	—	—	—	— —	—
14	423		HANDLINE	UKU	11	56	56	168 00	WAIANAE
				WHITE ULUA	2	32	32	32 00	
				KAHALA	5	45	0	— —	
				TAAPE	47	33	33	24 75	
18	331		HANDLINE	OPAKAPAKA	23	104	104	337 50	KEWALO
				GINDAI	4	10	10	25 00	
				ONAGA	8	60	60	210 00	
19	331		HANDLINE	OPAKAPAKA	19	99	99	321 27	KEWALO
				LEHI	3	5	5	12 50	
				KALEKALE	7	11	11	22 00	
25	420		HANDLINE	OPAKAPAKA	11	21	21	57 75	KEWALO

See Instructions on Page 1

C-3 (Rev. 3/1/84)

FOR OFFICE USE

LOGGED _____
EDITED _____
CODED _____
SUBMIT _____

The above report is true, correct, and complete to the best of my knowledge and belief.

17. Signature: John Doe
Licensee or Authorized Agent

SEND THIS COPY

APPENDIX C

GLOSSARY OF TERMS

Abundance	The number of fish of a species present in an area of interest over a specified unit of time.
BMUS	Bottomfish management unit species. These are the commercially important bottomfish species which are outlined in the Introduction of this report.
BPMT	Bottomfish Plan Monitoring Team. See PMT for a description of team functions.
Catch	The number or weight of a particular species or group of species taken in a unit of time.
Catch-Per-Unit of-Effort (CPUE)	The average catch taken by a defined unit of fishing effort. In the bottomfish fishery, for example, the number or weight of bottomfish caught per vessel per day or per line-hour of fishing.
CNMI	Commonwealth of the Northern Mariana Islands.
DAWR	Guam Division of Aquatic and Wildlife Resources.
DFW	Commonwealth of the Northern Mariana Islands Division of Fish and Wildlife.
DMWR	American Samoa Department of Marine and Wildlife Resources.
Effort	A numerical measure of the amount of gear and time used in an attempt to catch fish. Effort may be expressed in terms of number of hooks fished per day, number of boat days, man hours, line hours, etc.
Fishery	A fishery is a composite of the following essential components: a resource consisting of a population of a species or set of species usually with similar ecological requirements or characteristics; a number of fishermen who regularly exploit the resource, together with their boats and equipment for harvesting and handling fish; and a market in which fishermen can sell their catch.

Fishery Conservation Zone (FCZ)	U.S. waters from the seaward boundary of a State or Territory to 200 nautical miles from the shoreline.
Fishery Management Plan (FMP)	A plan prepared by the Council and implemented by the Department of Commerce for the conservation and management of fishery resources in the Fishery Conservation Zone.
Growth-Overfishing	Overfishing which is a direct result of harvesting fish before they have attained an optimum size to sustain population productivity.
Hancock Seamounts	That portion of the FCZ in the NWHI west of 180° 00' W. longitude and north of 28° 00' N. latitude.
HDAR	Hawaii Division of Aquatic Resources.
KNK	Bottomfishing area in the Main Hawaiian Islands zone defined as those fishing areas around Kauai, Niihau and Kaula.
Magnuson Fishery Conservation and Management Act (MFCMA)	Federal law (P.L. 94-265, passed in 1976 and amended several times in subsequent years) covering fishing activity in U.S. waters between State waters and 200 nautical miles from the coastline.
Main Hawaiian Islands (MHI)	The high islands of the State of Hawaii consisting of Niihau, Kauai, Oahu, Molokai, Lanai, Maui, Kahoolawe, and Hawaii (from 154° W. Longitude to 161° 20' W. Longitude).
Management Unit	A species or a group of fish species affected or exploited by the same fishery or fisheries.
Management Unit Species (MUS)	In this Annual Report, the MUS include approximately 22 species of deepwater bottomfish and seamount groundfish.

MLKM — Bottomfishing area in the Main Hawaiian Islands zone defined as those fishing areas around Maui, Lanai, Kahoolawe, Molokai and Penguin Bank.

Maximum Sustainable Yield (MSY) — The greatest average amount, in theory, that can be harvested from a population of fish on a continuing basis.

Mortality — Refers to the death rate in a population from natural and fishery causes. Together these constitute total mortality. Mortality rates can be considered on an instantaneous or an annual basis (instantaneous mortality rates are the limits approached by average rates over progressively shorter periods).

National Marine Fisheries Service (NMFS) — The NMFS has the primary Federal responsibility for the conservation, management, and development of living marine resources and for the protection of certain marine mammals and endangered species under numerous Federal laws. The Agency also has responsibilities to the U.S. commercial and marine recreational fishing industry, including fishermen, and to the States and the general public.

Northwestern Hawaiian Islands (NWHI) — The Hawaiian Islands archipelago lying to the west of 161° 20' W. longitude.

OMWR — American Samoa Office of Marine and Wildlife Resources. This is an old title, and the office is presently called the American Samoa Department of Marine and Wildlife Resourcs (DMWR)

Optimum Yield (OY) — The amount of fish which produces maximum benefits to the Nation, especially considering food production and recreational opportunities.

Overfishing — A term often used to describe fishing at a level of effort in excess of the level needed to obtain the MSY. The term is also used to imply that fishing has reduced stock to such a level that its reproductive potential is reduced. Overfishing may occur in a fishery at different levels of effort for recreational and commercial users. This may occur, for example, when recreational users prefer fish of smaller size that commercial users.

Plan Monitoring Team (PMT) — A team appointed by the Council to prepare the fishery management plan and annual reports under the direction of the Council. The PMT utilizes inputs from all committees and panels as well as outside sources in developing the FMP.

PMUS — Pelagic management unit species defines those species which are commercially important to pelagic fishermen, exclusive of tunas.

Recruitment — The rate at which new fish (recruits) enter the fishery by reaching catchable size or reaching an age where their distribution and behavior makes them vulnerable to the fishing gear, or the total amount of recruits added in a given period of time (i.e., the recruitment rate integrated over the time period), or the process of adding recruits.

Stock — A population or portion of a population that can be treated as a single unit for management purposes.

Western Pacific Regional Fishery Management Council (WPRFMC) — The Western Pacific Regional Fishery Management Council shall consist of the State of Hawaii, the territories of American Samoa and Guam, and the Commonwealth of the Northern Mariana Islands. It shall have authority over the fisheries in the Pacific Ocean seaward of the jurisdiction of such State, territories, Commonwealth, and possessions of the United States in the Pacific Ocean area out to 200 nautical miles from shore.